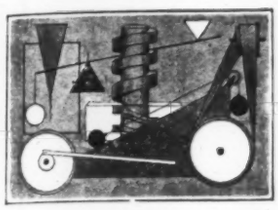
MACHINE DESIGN

as it affects

ENGINEERING–PRODUCTION–SALES

Volume 4 | August, 1932 | Number 8



Next MONTH

BABBITT or bronze—which shall it be? Here's a question that has troubled designers for years. Each material has been treated separately in numerous discussions, yet little has been published on their comparative characteristics.

MACHINE DESIGN is in the fortunate position of being able to include in its schedule for September a concise article dealing with the applications of the two materials from the standpoint of relative merit. The contribution will help considerably to straighten out the complexities of this situation.

L. E. Jermy

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MACHINE DESIGNER
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ANY machinery designer who does not extend his vision beyond the drawing board and experimental department unthinkingly handicaps his company's success today. Now, more than ever before, the influence of design on saleability is a primary consideration.

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Itemized Index for August, 1932

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

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THE value of research is apparent to every engineer. Keeping informed of what research data is available, however, has presented somewhat of a problem. To assist readers in this direction, Machine Design now gives each month a selected list of "Research Publications", an outline review of the contents and where and how they can be obtained. Thus, considerable pertinent and usable technical information is made available to the engineer. Many of the publications listed can be had for a nominal sum. The new department will be found in this issue on page 54.

CALENDAR OF MEETINGS AND EXPOSITIONS

Aug. 22-26—American Chemical society. Included in the program for the eighty-fourth meeting of the society to be held at Denver, Colo., are papers on "X-Ray Analysis of Metals and Alloys," by G. L. Clark; "Some Applications of Fundamental Theories of Metals and Alloys to Practical Manufacturing Problems," by Anson Hayes, symposia on "Industrial Coatings Related to Paint and Varnish" and "Primers and Protective Coatings for Special Metals." Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary.

Aug. 28-Sept. 1—Leipzig Trade Fair—Annual international exhibition of parts and machinery to be held at Leipzig, Germany. The fair will include some 8000 exhibits contributed by 25 countries. Information on the exhibition may be obtained from the offices of the Leipzig Trade Fair Inc., at 10 East Fortieth street, New York.

Aug. 30-31—Society of Automotive Engineers. Aeronautic meeting to be held at Hotel Statler, Cleveland, in connection with the Aeronautical Chamber of Commerce of America, during the National Air races. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Sept. 5-10—National Association of Power Engineers. Exhibition of equipment and annual meeting to be held at Milwaukee. Fred W. Raven, 1140 Lake street, Oak Park, Ill., is secretary of the association.

Sept. 14-16—Technical Association of the Pulp and Paper Industry. Annual fall meeting is to be held at Hotel Nonotuck, Holyoke, Mass. R. G. Macdonald, 370 Lexington avenue, New York, is secretary.

Sept. 14-17—American Trade Association Executives. Annual meeting to be held at Hotel Ambassador, Atlantic City, N. J. W. J. Donald, 20 Vesey street, New York, is chairman of the meeting.

Sept. 19-23—American Society of Mechanical Engineers. National Wood Industries meeting, and exhibition of commercial and educational displays to be held at Jamestown, N. Y. The program includes four technical sessions, and plant inspection trips. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

Sept. 22-24—The Electrochemical society. Sixty-second fall meeting will be held in Cleveland and will include sessions on electric brass and steel and on electrodeposition. Colin G. Fink, Columbia university, New York, is secretary.

Sept. 27-29—New Products conference. The Cleveland Engineering society is sponsoring this conference which is to be a clinic held at Cleveland for the study of every phase in the development and marketing of new products. Information on the conference may be obtained from Carlton R. Sabin, 410 Hanna building, Cleveland, secretary-manager of the society.

Oct. 3-7—National Safety council. Twenty-first annual meeting to be held at Washington. W. H. Cameron, 20 North Wacker drive, Chicago, is managing director.

Oct. 3-7—National Metal exposition. Annual exhibition of materials and equipment to be held at 174th Regiment armory, Buffalo, N. Y. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is director of the exposition.

Oct. 3-7—American Welding society. Annual meeting in conjunction with National metal congress to be held at Buffalo. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Oct. 3-7—American Society of Mechanical Engineers. National Iron and Steel and National Machine Shop Practice meetings to be held at Hotel Statler, Buffalo, in conjunction with National Metal congress. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

Oct. 3-7—American Society for Steel Treating. Annual National Metal congress to be held at Buffalo with the co-operation of American Society of Mechanical Engineers; institute of metals and iron and steel divisions of American Institute of Mining and Metallurgical Engineers; American Welding society; and Wire association. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary of the American Society for Steel Treating.

Oct. 17-22—Southern Textile exposition. Machinery, accessories and supplies are to be displayed at this tenth annual exposition at Textile hall, Greenville, S. C. Information may be secured from the Textile Hall Corp., at Greenville, S. C.

Oct. 17-22—Dairy and Ice Cream Machinery and Supplies association. Annual meeting and exposition of equipment at Convention hall, Detroit. C. E. Breece, 225 West Thirty-fourth street, New York, is secretary.

Oct. 19-21—National Association of Farm Equipment Manufacturers. Annual meeting to be held at Congress hotel, Chicago. H. J. Sameit, 608 South Dearborn street, Chicago, is secretary of the association.

Oct. 20—National Advisory Committee for Aeronautics. Annual meeting at Washington. J. F. Victory, 3841 Navy building, Washington, is secretary.

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

August, 1932 Vol. 4—No. 8

Ingenious Drive Distinguishes Mechanical Harvester

By Allen F. Clark

Editorial Representative, Machine Design

THOUSANDS of patents have been granted for cotton harvesting machines since 1850, yet it has been only in the last few years that designers have subdued the major requirements that have limited previous success of a machine of this type. Mechanical cotton pickers, to be successful, must gather a good majority of the ripe cotton and substantially nothing else, and in accomplishing this, must not injure either the cotton or the various parts of the plant; they must operate efficiently in cotton with green leaves and in that with dead leaves and stems; they must be capable of operating efficiently in most types and sizes of plants, but need not be capable of handling abnormally large or small plants inasmuch as these are relatively few in number; and they must be so constructed that no oil can get on the cotton.

These requirements are met in the design of the Gyracotn harvester by Geo. R. Meyercord and Associates, Chicago, which incorporates rotating drums and picking hooks or fingers and an ingenious friction drive that also has application in industries far removed from that of mechanical harvesting.

Before going into the other mechanical details of the harvester, it might be well to visualize the problem presented by nature in the

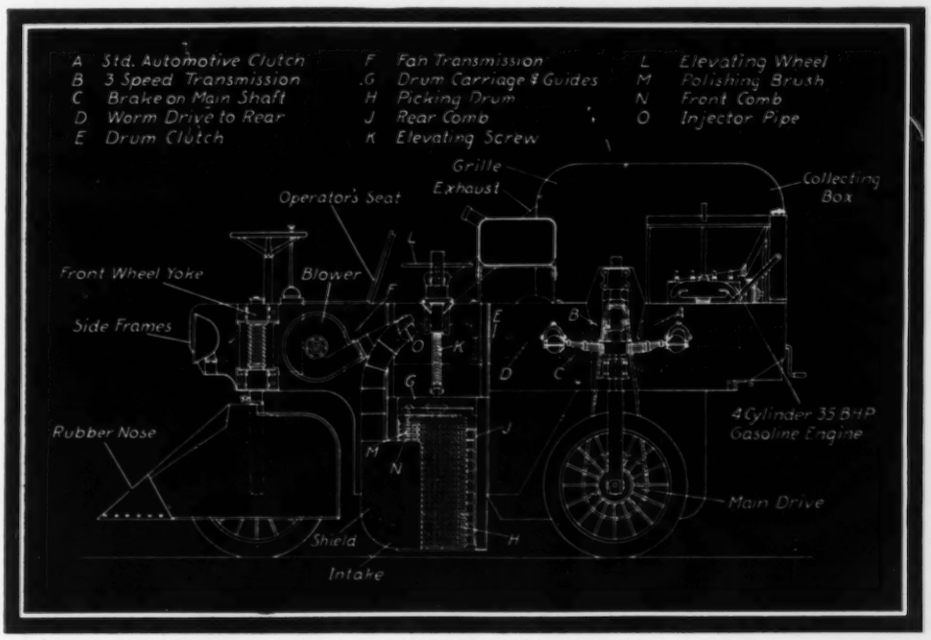

Fig. 1—Picking fingers on revolving drums shown in center have forward and reverse direction of rotation for picking and releasing cotton

growing of cotton. The plant is covered profusely with green leaves, the lower surfaces of which have, in many cases, a nap-like growth apt to catch the cotton fibers. Live plants are extremely flexible, but the leaves fall off at the first frost and the branches soon become brittle.

The cotton boll, before it opens, is shaped somewhat like a hen's egg, although more pointed. As it matures, the green shell splits into four or five parts, beginning at the tip opposite the stem. These split parts adhere to the stem and gradually curl back, exposing the cotton.

All bolls on the plant do not ripen at the same time; the early bolls not far from the ground open in September; from week to week additional bolls open farther from the ground; after frost, well matured bolls open rapidly, and the last of the cotton is ready for picking. At any one picking there may be on the average plant three or four bolls suitable for picking, generally most open bolls being nearest the base. In manual picking, the workman not only sees the location of each well opened boll but he notices its orientation. His hand approaches it in such a way as to grasp the cotton without touching the shell and he pulls it out with one motion.

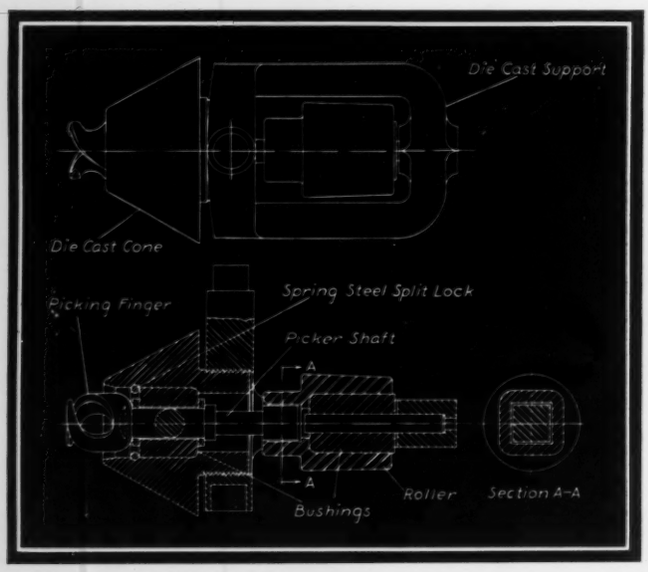

Fig. 2—Molded rollers mounted on paraffined maple bushings run on hardened and ground shafts in picker unit

The blind machine must make picking motions all over the plant but these picking motions must not injure the plant or the green bolls. They must result in the collection of most of the cotton that is ready for picking and substantially nothing else. At least one picking must be made while the plants are in full foliage.

This year's model of the Gyracotn harvester, Fig. 3, differs from the 1931 model principally in the use of a picker drive the performance of which is little affected by possible wear in service. The machine, a cross-sectional view of which is shown in Fig. 1, runs on spring-mounted wheels having zero pressure tires spaced to give a tread of 37 to 38 inches, the normal distance between rows, and has a short wheel base, about 87 inches, to provide for a small turning radius at the ends of the rows. Front wheels are equipped with sheet metal wheel guards, rubber tipped to allow them to pass between

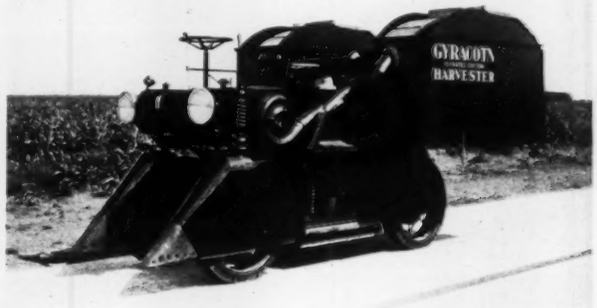

Fig. 3—Rubber tipped shields on wheel guards prevent damage to plants

the cotton rows with a minimum disturbance of the plants on each side. The driver's seat is mounted at the extreme top and front of the machine to permit exact control of all moving parts and of the relative position of the machine with the plants.

As the machine passes along a row of plants the two drums driven through gears from the main shaft rotate, compressing the 2-foot diameter plants laterally and feeding them through the 2-inch opening between the drum surfaces, *H*, Fig. 4. The central stalks are left nearly vertical throughout the process. One drum is rotated somewhat more rapidly than the other, giving a rolling or twisting action to the plant between the drums. This results in no appreciable injury and gives the hooks or picking fingers an opportunity to engage all open cotton.

Slightly Blunt Hooks Are Used

The complete picker is shown in Fig. 2. Cotton is picked out of the bolls by the slightly blunt picker hooks which are rotated frictionally about their centers at 3000 revolutions per minute. When the picker shaft is rotated, the hooks readily engage the cotton but no other part of the plant, and they throw the cotton off when rotation is reversed. There are no sharp points or sudden projections on the fingers. To such materials as leaves, the finger is no more effective than a solid piece of metal with no prongs. With loose fluffy material such as cotton, however, the prongs are extremely efficient and instantaneously engage and hold the fibers. The picker cones, Fig. 2, with their projecting hooks are mounted on the cylindrical surfaces of the drums, *H*, Fig. 1. On each drum there are 828

picker cones in horizontal and vertical rows, spaced 10 degrees apart horizontally and 1-3/16 inches apart vertically. Drums are 14 inches in diameter by 29 inches high. The horizontal rings of picker fingers on one drum are staggered with those of the other.

Pickers are driven forward, in the direction of their hooks, throughout a drum rotation of 200 degrees, Fig. 4, beginning at the front line of the drum. This driving begins early so that the pickers will be up to speed and ready to receive a boll at the first opportunity. The smooth hooks are pressed into the cotton in the process of compressing the plants, their rotation not only improving the hold upon the cotton first engaged, but gradually extending the grip to a much larger part of the boll. As the picker moves away from contact with the plant, the cotton already engaged begins to rotate as a whole and entangles other parts of the boll; the entangling process continuing until all of the cotton in the boll has been drawn into this twisting mass.

ALTHOUGH one man equipped with agricultural machinery can raise 100 acres of cotton, producers have been unable to profit by this ability because this man cannot harvest the cotton from such an area by hand. It takes about six helpers to harvest this crop and, in most cases, help cannot be imported. This necessitates the maintenance of a surplus population throughout the year. The cotton grower must either lose the profits available by the use of machinery or apply a mechanical harvester. Even under present conditions there is an enormous waste of cotton because of lack of help for picking. Cotton should be harvested as soon as practicable after the boll opens inasmuch as its value is reduced considerably by pests, dust and rain. This condition indicates a genuine economic need for a mechanical harvester.

When the twisting extends to the bottom of the shell, the cotton is released from the plant.

Forward driving of each picker stops after it has passed the rear of the drum by 20 degrees, Fig. 4. The picker then is free to idle while the drum rotates 40 degrees, and in this period nothing happens except that the picker loses speed and the attached cotton begins to untwist. Reverse driving of the picking hook is commenced when it has passed the rear of the drum by 60 degrees. Its rotation now is accelerated rapidly in the opposite direction, thus completing the untwisting of the cotton. Then, aided by the rim of the picking cone, the hooks throw off the cotton into the mouth of the suction pipe.

If there is any delay in the removal of the cotton from the picker, the teeth of a front comb, *N*, Figs. 1 and 4, come into use. They are so spaced 10 degrees apart horizontally and 11 3/16 picker passes, checking the reverse rotation of the cotton and lifting it off the unit as the hooks back away from their grip.

Cotton leaves contain a mucilage-like sap

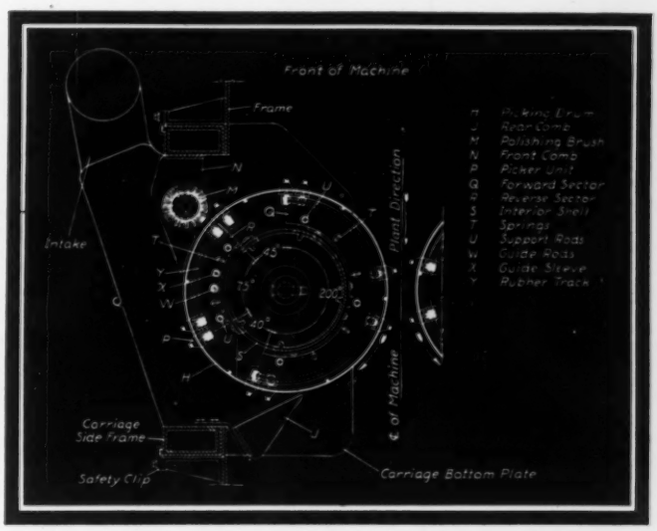

Fig. 4—Relative arrangement of drum parts permits easy reversal of pickers and collection of cotton

which soon coats all pickers unless means are provided for keeping them clean. This sap attracts dust and cotton fibers eventually clogging the fingers so badly that they are unable to grasp cotton. This problem is combated by a polishing brush, *M*, Figs. 1 and 4, driven by chain from the drum, which the picker fingers contact just beyond the front comb. Running at about 1000 revolutions per minute, the tips of the bristles are well adapted to enter the picker head and clean its hooks, the picking unit still being driven in reverse. The picker is idle throughout the last 45 degrees rotation of the drum, at the end of which it is again on the front line of the drum, ready to begin another cycle.

Oil Cannot Be Used

It is considered fundamental that the pickers shall not distribute oil even in small quantities, to the cotton. Therefore, they are driven by friction instead of by gearing. A tapered molded bakelite roller, ½-inch diameter, Fig. 3, runs on a stationary rubber track, *Y*, Fig. 5, the normal force between roller and track being from 2½ to 3 pounds, giving a picker about 12 inch-ounces of torque. Roller load is carried by the bearing within the roller, no part of it going to the exposed outside bearing near the picker head. This is done because of the better operating conditions of the interior bearing. The roller contains a paraffined maple bushing rotating on a hardened and ground steel pin of smallest practicable

diameter. Another paraffined bushing is used as the bearing for the picker head shaft, held in place by a split ring lock.

The sectors for driving the picker rollers are shown in Figs 4, 5 and 6. These are segmental rubber tracks, *Q* and *R*, 200 and 75 degrees angular length and 5/16-inch wide, supported by aluminum sectors. They slide on vertical rods

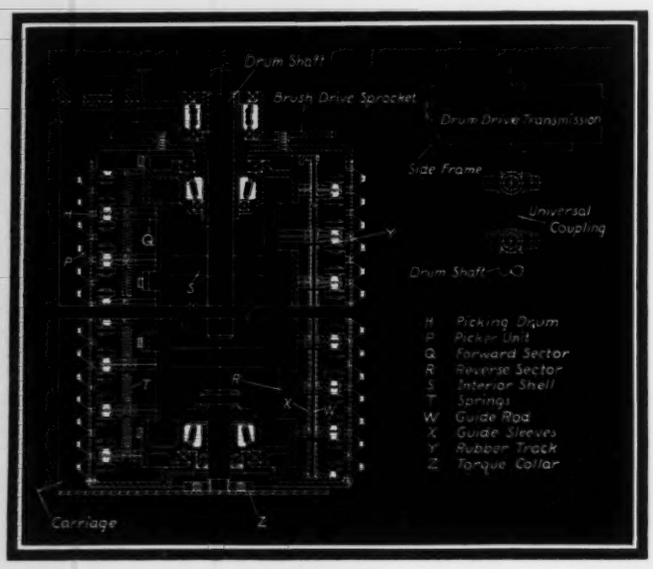

Fig. 5—Drum section with portion to right of center line taken through guide sleeves on reverse section, to left through springs on forward sector. Method of allowing for sidewise movement of drum is shown in insert

U, Fig. 4, attached to the interior shell. Tracks are placed alternately above and below adjacent horizontal rows of picker rollers, requiring the use of right and left-hand picker heads. Reversal of direction of rotation of the picker heads is effected by arranging the reverse sectors to operate on the opposite side of the rollers from that of the forward sectors. Adjacent track sectors are connected by tensile springs, *T*, which provide the requisite loads on the rollers.

Sleeves Are Required

For odd sectors at top or bottom, Fig. 5, springs are attached to lugs on the central drum core. For the 200-degree sectors used for forward driving, the springs are arranged symmetrically with respect to the center of gravity of the track, but the reverse 75-degree sectors are too short to permit this arrangement. This necessitates the use of sleeves, *X*, Figs. 5 and 6, attached to the disks and held in correct angular position by guide rods, *W*, to prevent tilting of the sectors. The vertical guide rods hold the sectors in correct radial and circumferential position while they are individually free to find their correct vertical positions.

At the leading edge of each track the rubber is replaced by leather to receive the shock and wear incident to starting up the picker rollers. As the track wears, the springs draw the sectors closer together with little change in the tension of the springs. Periodical replacement of the rubber tracks is simple and inexpensive.

In studying the friction drive by which these rollers are turned, it should be kept in mind that the exterior drum carrying the pickers and the rollers rotates, while the interior shell with the driving sectors is held stationary. The weight of the drum is taken by a bearing at the top, Fig. 5, while the interior is restrained from rotation through the bottom bearing. Each drum and all its surrounding mechanism is carried by a rectangular carriage which has a sliding motion of about 9 inches in vertical guides, Fig. 1, to permit the drums to operate at various ground clearances necessary for different heights of plants. The exterior drum shell is driven by a stub shaft which has a long keyway to facilitate running at different elevations. This shaft is driven through a universal joint, Fig. 5, which permits variation in drum spacing and allows outward swinging of the carriage in case the

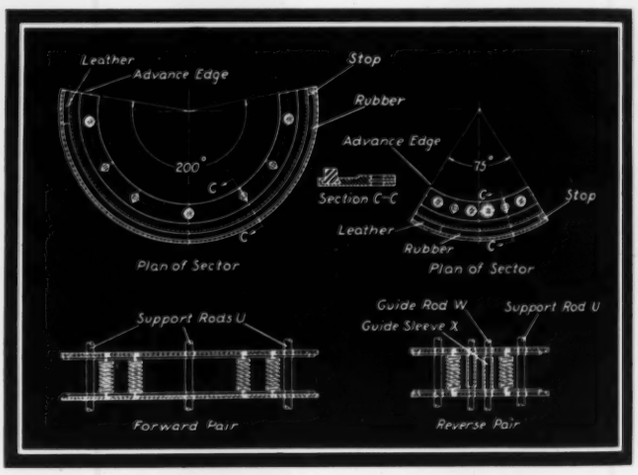

Fig. 6—Driving track is made up of leather and rubber sections and has an aluminum stop at the end

drums are called upon to allow some large object to pass between them. Ordinarily, the carriage is held in its vertical track by means of brittle cast iron safety clips, Fig. 4.

As was noted in the foregoing, the cotton, when released by the pickers, is thrown directly into the intake mouth of a pneumatic conveying system, shown in Fig. 1. A siphon system is used, eliminating the necessity of passing cotton directly through the fan. The siphon system is further advantageous in that it affords an extremely high velocity at the outlet, in this case about 10,000 feet per minute, permitting the effective use of a grille separator. The cotton strikes an open grille work over the front part of the collecting box which guides it into place in the box but allows the air and any sand, dirt or other foreign substance to flow out through the grille.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Compactness Augments Appearance

LONG antiquated, old type domestic furnaces are giving way to modern heating equipment including oil burners into which the designer has incorporated refinement in the form of silent mechanisms, improved nozzles and revolutionary methods of combustion. New units are setting a pace in engineering development that without doubt will be reflected to a large extent in all supplementary equipment; depending, of course, on the designer's foresight in grasping these prevailing opportunities.

Appearance is one asset of the new oil burners. Typical of this factor in design is the unit depicted in Fig. 2, developed recently by General Electric. The furnace comprises a co-ordinated boiler, burner and control, Fig. 1, manufactured as one unit. The combustion principle embodies the blowing of finely divided particles of oil from the nozzle under air pressure. A small amount of air fed in around the nozzle cools it and also the electrodes, starting combustion some distance below the nozzle.

Greater part of the air supply, however, is taken from the blower through a duct at the left side of the furnace and enters the bottom of the combustion space. Meeting and mixing of the burning oil vapor spray with this secondary air supply produces a diffused flame. The burner is of compact design having all rotating parts mounted on one shaft and lubricated under pressure by a sealed-in oil supply.

Control and the oil burner unit mounted above the boiler are enclosed under a tightly fitting cover, Fig. 1. Air is drawn into this space through louvers in a duct at the right side of the furnace. By drawing air into the enclosure through a duct, the pressure in the upper compartment is maintained less than atmospheric. Hence traces of oil vapor cannot escape into the basement, but are drawn along with the air into the blower and unite with the oil being burned in the combustion chamber.

Steam is employed to atomize the oil in an oil burner the Walworth Co., New York, has under development. As recorded in the *Industrial Bulletin* of Arthur D. Little Inc., the chief advan-

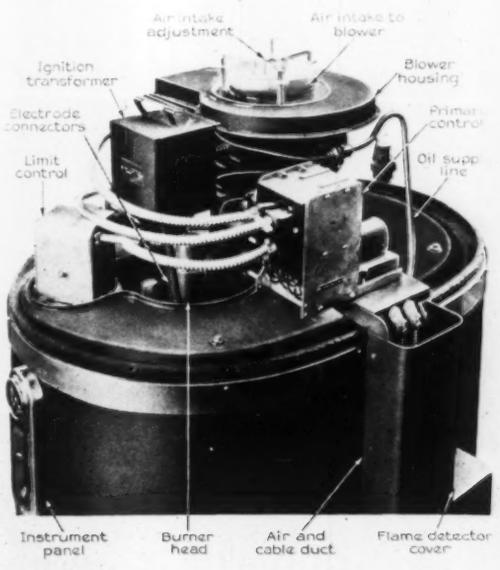

Fig. 1—(Left)—Top of oil furnace, cover removed to show burner and control devices. Air is drawn into this space through louvers in a duct at the right side of the unit

Fig. 2—(Right)—The clean cut design and pleasing appearance of this furnace is an outstanding characteristic. Boiler, burner and control are coordinated as a complete unit

tage of this lies in the simplicity of design and operation. Steam atomization also keeps the burner tip free from clogging with soot and tar, as well as permitting the use of heavier and less expensive fuel oil while maintaining smokeless combustion. The burner is started by turning on the oil and lighting an asbestos wick under the nozzle, which generates sufficient steam in about three minutes to insure proper and automatic operation.

In the May company's oil burner the nozzle has sapphire jeweled channels through which the oil passes. Precision of the jeweled orifice is maintained regardless of the quality of oil used.

Revolutionizing the Speed Boat

COMPARED with the horsepower required to drive automobiles and airplanes at high speed, the increase in power necessary to propel a boat at a corresponding rate is far out of proportion. The only conclusion that can be drawn, therefore, is that the conventional method of boat design is open to considerable improvement. In this field of vast opportunities for designers, Dr. Oskar G. Tietjens, Westinghouse engineer, has conducted tests on a model incorporating means to lift the boat entirely out of water, allowing it to skim along the surface on two small planes, Fig. 3.

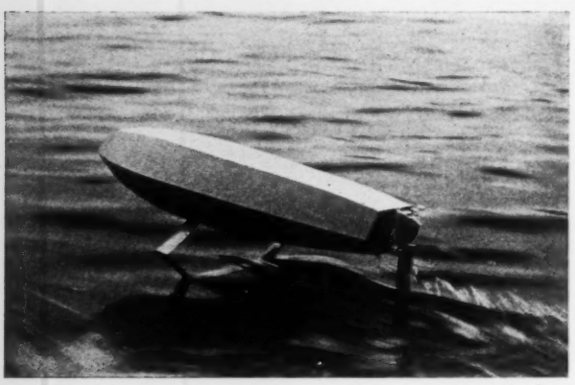

Fig. 3—Hydrofoils demonstrate a new idea in boats

It is predicted that with this arrangement a speed boat capable of 25 miles an hour in water will be able to go 40 miles an hour with no increase in power when lifted into the air by the submerged planes. The idea appears practicable in this form for boats ranging in size from 12 to 50 feet long. Motion pictures of tests with his model were shown by Dr. Tietjens at the recent meeting of the applied mechanics division of the American Society of Mechanical Engineers.

Speed boat lines were followed in shaping the four-foot model and a fixed hydrofoil was attached at about the normal waterline just forward of amidship. It is perpendicular to and beneath the hull, a cross section resembling that of an airplane wing. For a twelve foot boat the hydrofoil would need be only eight inches wide. At the stern, just forward of the propeller, is the second hydrofoil. This is fastened to the streamlined housing of the propeller shaft and can be tilted up or down.

When the forward edge of this movable hydrofoil is lowered, it cuts down into the water, lowering the stern of the boat. Automatically this increases the lift of the forward hydrofoil and the nose of the craft climbs entirely out of the water as the speed increases. Gradually the aft hydrofoil is brought to a position which also lifts the stern out of the water and the boat is then riding on the two narrow planes. Tests showed no tendency for the model to overturn while riding on the small plane surfaces.

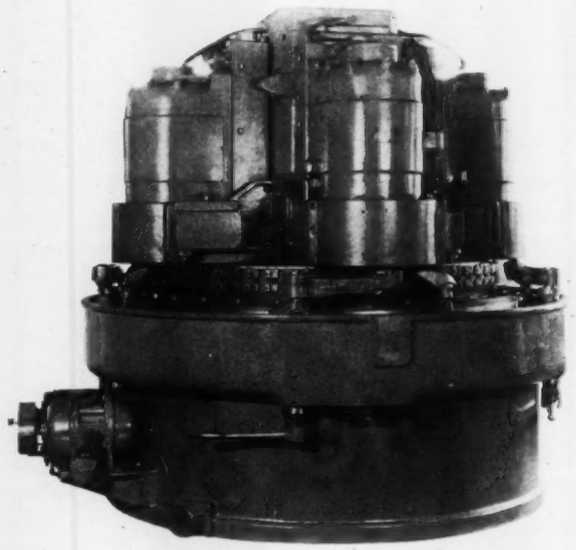

Fig. 4—This rotary surface grinder exemplifies new trends

Electrical Devices Aid Automaticity

ENTERPRISING engineers have been quick to see the possibilities of built-in motors, automatic sizing and gaging devices, solenoids, limit switches, etc., in their quest to meet the exacting requirements of modern shop practice. Veritably a composite of these features, with appearance as an outstanding adjunct, is the rotary surface grinder built recently by Hanchett Mfg. Co., Big Rapids, Mich. Roughing, semifinishing and finishing cuts may be taken on a piece of work without removing it from the revolving circular table. Grinding wheel heads driven by built-in motors as shown in Fig. 4, are mounted on a central column.

The machine depicted is set up to grind valves at a rate of 35 per minute. Both ends of the valves, held on the table as shown, are ground to within a tolerance of .001-inch for length and

.0003 for run-out. Three automatic sizing devices are mounted on a vertical slide, the contact point being positioned directly over the path of the work. If the piece has not been ground off sufficiently it makes contact with the gaging point, which in turn operates a solenoid device connected through a ratchet and pawl so as to operate the wheel feed screw. Limit switches connected to three red flash lights at the front of the machine warn the operator when the grinding wheels are worn to their limit. This arrangement also disengages the feed.

Electric Eye Registers Color

APPLICATION of the photronic cell or electric eye is increasingly being effected by designers. One of the recent innovations is its use on a Talbutt electric coffee roaster to indicate when the coffee beans have reached the desired shade of brown. The method in which the electric eye is set to register the correct shade incorporates the use of a color standard.

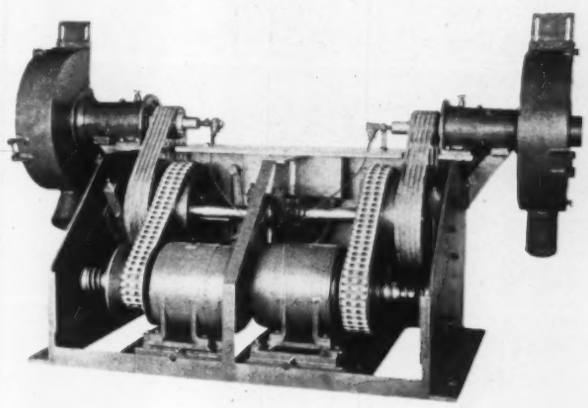

Fig. 5—Peripheral speed of the wheels is controlled in this unit through employment of variable drives

On one side of a metal plate is the proper shade, with a slightly lighter cast of brown on the other side. Because the roasting coffee passes the photronic cell so fast and in a solid sheet, it has the appearance of being a shade lighter than it actually is. Therefore, the cell is set to register on the lighter side of the plate.

Chart Indicates Peripheral Speeds

CONTROLLED variation in speed of machinery is essential, particularly when peripheral speed of mediums such as grinding wheels governs the efficiency of the operation. In grinding practice the life of the wheels also must be taken into consideration. Meeting the requirements of these conditions a new floor stand grinder, Fig. 5, recently was developed by the Production Equipment Co., Cleveland, incorporating a variable speed motor pulley.

On the wheel guard is a chart movable vertically in accordance with the outside diameter of the wheel. The chart contains figures showing the spindle speed necessary to permit operation of the wheel at peripheral speeds between 7500 and 9500 surface feet per minute. Movement of this plate to a position where it clears the grinding wheel by approximately ¼-inch shows the operator automatically the correct spindle speed to use to obtain the desired peripheral speed.

Connected to one end of the spindle is a tachometer, the connecting shaft running from the spindle to the indicating head located at the front of the machine and directly under the motor control button. Speed of the grinding spindle is adjusted by moving the handwheel located on the front panel, until the tachometer head indicates the requisite revolutions per minute.

Variation in the drive is effected by a Reeves variable speed motor pulley unit mounted on a standard motor. A screw rotated by the handwheel through a chain drive moves the motor along its sliding base, at the same time controlling the variable pitch diameter or operating point of the driving pulley.

Ceramic Material Yields Bearing

THAT the machine is a derivative of practically every phase of engineering, ceramics included, is confirmed by disclosure of a new scale bearing made from a compounded material by the extrusion process. Scales require a bearing with an extremely accurate V-shaped groove in which the fulcrum rests.

Agate scale bearings carefully ground to shape and highly polished have answered this need; however, their expensive production frequently has militated against their use. It was Henry L. Crowley, a ceramic specialist of West Orange, N. J., who recently introduced a solution to this problem with the development of the new bearing, Fig. 6, which can be produced at low cost. The part is made of crolite, a compounded material.

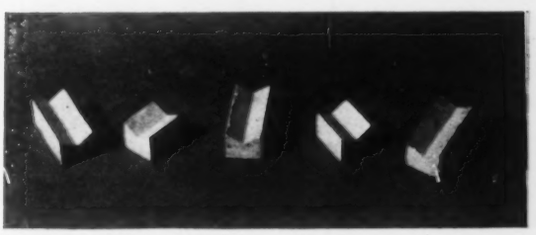

Fig. 6—Composition scale bearings are extruded and fire hardened

In production of this type of bearing the raw material is extruded in continuous lengths from a die of exact cross section, then cut into small pieces to form the blocks, and subjected to precision firing to acquire the proper hardness.

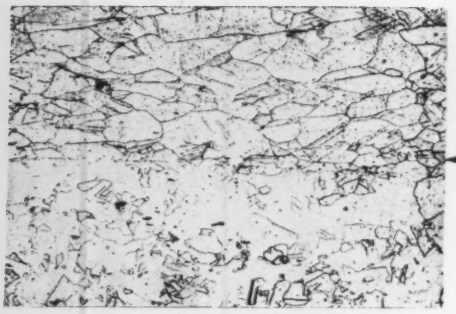

Fig. 1—Photomicrograph of the edge of a bimetal strip 0.040-inch thick made by direct weld

Utilizing Temperature in Control of Parts

By Howard D. Matthews

THERMOSTATIC metal in the form of bimetal has become an active item in industry only during the last ten or fifteen years. Its action of "bending with the heat" has been of considerable interest to design engineers where temperature enters into the action of a machine or influences the quality of its product.

One of the first known principles of heat, namely, "Heat expands most substances" was observed so long ago that its origin is lost in history. The artificers whose ingenuity in the art of hammering copper and iron into armor plate made it possible for the knights to "ride forth" with the necessary boldness were well acquainted with this principle, as evidenced by heating of hoops and tires during assembly of casks and wheels a method which hardly has been improved upon even up to the present time.

Principle Used Two Centuries Ago

As a control medium, the expansion of metal first was used at least two centuries ago for operating dampers on stoves. As the elongation with increase of temperature was relatively small, levers were used for magnifying the motion into usable values. Such devices were called "pyrometers." One hundred years later two strips were fastened together in a laminated structure and the bending motion observed. The deflection was small due to the limited number of available materials and possible lack of exact data on their expansive properties. However, the movement obtained per degree temperature change was much greater as compared to the elongation of either element if used alone. Materials such as gold, silver and platinum were experimented with. Strips were soldered together, and when bent into coils sufficient rotation was obtained for making thermometers.

During the last thirty years, due to progress in metallurgy, alloys have been developed with low as well as high thermal expansivity and applied to thermostatic bimetal. Heaters for buildings, machines for making clothing and shoes, instruments for guiding airplanes, controls for automobile engines—all contain a small piece of bimetal which acts as the "brains" of the device, causing it to function in a predetermined way under certain conditions.

The bending of bimetal is illustrated in Fig. 3, degree of bending for a given temperature rise, neglecting the physical dimensions, depending

TABLE I

Relation of Length and Thickness of Bimetal in Strip Form to Deflection

Length, inches	Thickness, inches	Deflection at free end, 100 degrees Fahr. change, inches
2	.015	1/8
2	.030	1/16
2	.060	1/32
4	.015	1/2
4	.030	1/4
4	.060	1/8
6	.015	1 1/8
6	.030	9/16
6	.060	9/32

upon the relative differences in the thermal expansion coefficients of the components used. For the low expansive side, Invar has been the popular alloy used. This alloy consists of 36 per cent nickel and 64 per cent iron and has an extremely low thermal expansivity at ordinary temperature. Dr. C. E. Guillaume of France invented Invar in 1899 while searching for an accurate material for standards of length measures and for balance wheels in watches and clocks. This alloy has only one fifteenth the thermal expansivity of brass, so that the bimetal on the market today made of Invar and brass has a high degree of sensitivity. Some idea of the deflection can be obtained by referring to Table I. The values given are for average sizes in actual use in the form of a straight strip. The movement can be expressed by the general formula:

TABLE II

Thermal Expansion Characteristics of Some Common Materials

Material	Coefficient of Linear Expansion, 20-100 degrees Cent. (average)
Rubber (Hard)	.0000840
Porcelain	.0000300
Lead	.0000292
Zinc	.0000292
Aluminum	.0000231
Tin	.0000224
Silver	.0000192
Brass	.0000190
Copper	.0000159
Gold	.0000144
Monel	.0000140
Nickel	.0000137
Iron	.0000114
Platinum	.0000086
Nickel Steel (45% Ni)	.0000081
Nickel Steel (42% Ni)	.0000050
Nickel Steel (40% Ni)	.0000030
Nickel Steel (36% Ni)	.0000016

$$D = \frac{k\,(T_1 - T)\,l^2}{t}$$

where

D = deflection at free end of strip
$T_1 - T$ = temperature rise
l = length of strip
t = thickness of strip
b = width of strip
k = constant depending upon the metals used

If the strip is wound in the form of a helix or spiral as shown in Fig. 2, an angular movement is obtained and such action can be expressed by the formula:

$$A = \frac{k\,(T_1 - T)\,l}{t}$$

where

A = angular rotation in degrees

From the last formula it will be noticed that the number of turns and the diameter of the coil do not enter into the calculation. The same formula also applies for coils in either the helix or spiral form.

These formulas of course are limited in use to a range of temperature in which the movement is proportional to the change in temperature. At extreme limits, either high or low, due to thermal anomalies which may occur in the alloys, the deflection may become irregular and cannot be expressed by a simple formula.

Bending a Natural Reaction

Invar and brass bimetal is limited to a maximum temperature of 300 degrees Fahr. For higher temperatures brass has been replaced by various alloys containing iron, copper, zinc, chromium and nickel, in a number of percentages and combinations. Some combinations are suitable for use up to red heat (1000 to 1200 degrees Fahr.) without the metal showing any impairment. From the requirement of the bimetal manufacturer the two metals to be fabricated not only must be vastly different in thermal expansion and be suitable for welding, but their hardness and elastic properties must be comparable in order to respond properly to the rolling and annealing processes. Any limitations that are placed on the raw materials carry through to a certain extent into the finished product. The bending with heat is caused by natural physical laws and no magic qualities are introduced thereby.

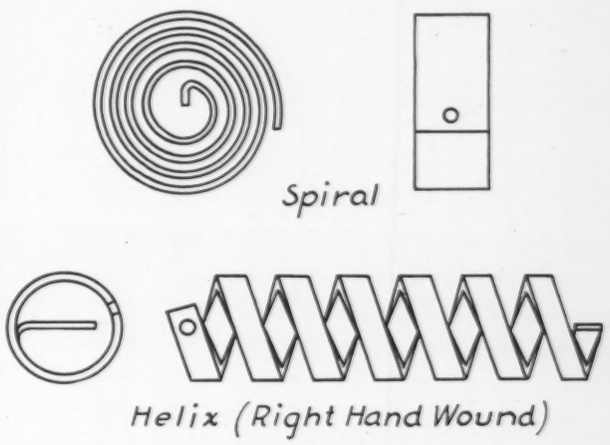

Fig. 2—Where a rotating motion is desired the material may be used in coil form

Expansion coefficients of some common materials are listed in Table II. A study of these values will suggest readily the fitness of many of the materials for bimetal combinations. Several patents have been issued covering the most efficient materials listed as well as other alloys of a more complicated nature. It is unfortunate that some of these materials with high expansivity are not suitable for use due to low melting temperature, low modulus of elasticity, or unsuitability for welding. In early design, rivets and solder were used for fastening together the two elements. Present day methods include di-

rect welding which makes possible a product adaptable for extremely high temperature applications. The photomicrograph Fig. 1, shows a direct weld sample. It will be noted that at the

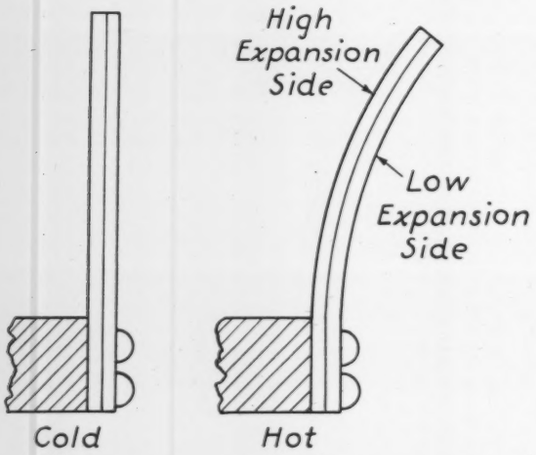

Fig. 3—Bending action due to increase of temperature of strip made from two materials with different coefficients of expansion

point of juncture there is no appearance of a seam.

From a design application standpoint, it is desirable to have the bimetal as sensitive as can be made economically. Such results permit a closer control and reduce the size of the piece to a minimum which is of great advantage in changing manual operating devices for automatic operations, as space usually is at a premium in such modifications.

In adapting the elements to actuate contacts, operate levers or valves, or move indicators, the exact shape to be utilized may be a straight or curved strip or a hair pin shape or coil, depending upon the motion required. Size is influenced by the magnitude of the motion as well as the force to be exerted. As far as endurance is concerned thermal bending of bimetal is much more favorable than mechanical bending. Bimetal is cold rolled in finishing to give it the necessary resilience and strength, but has no temper in the sense of spring steel. Tests made upon properly designed parts show records over a period of several years with thousands of operations. Such reliability in action has resulted in this type of material being applied to many classes of apparatus, some of the more prominent being given in table III. The temperature differential and range of adjustment as given are for average conditions. In some special applications the control valves depend upon the exact conditions to be met.

TABLE III

Operating Temperatures of Various Devices With Automatic Control

Appliance	Temperature variation, degrees Fahr.	Range of adjustment, degrees Fahr.
Incubator	¼	103
Room Control	1	60 - 80
Refrigerator	2	40 - 50
Sterilizer	5	125 - 300
Vulcanizer	5	296
Water Heater	5	130 - 180
Solder Pot	15	400 - 600
Damper	25	200 - 500
Motor Protection	....	175 - 200

Develops New Combustion Process

THE breakdown of a single globule of ordinary furnace oil, no bigger than the head of a safety match, into more than 100,000,000 particles, has been achieved through a new development in the General Electric laboratories. The oil, under pressure, is brought into a direct head-on impact with air under approximately the same pressure, causing superfine atomization and facilitating easy conversion of the small particles into a gaseous hydrocarbon by heat. This enables the entire energy of the fuel to be converted into heat without any loss of carbon in soot or smoke, and without excessive combustion air. This new principle is described as "progressive impact combustion" and laboratory application indicates a much more economical employment of oil as a fuel for heating purposes.

Progressive impact combustion permits more economical employment of oil as a fuel

In the application of this principle, the complete combustion of oil occurs progressively in three stages. First, the head-on collision of oil and air under pressure breaks up each drop of oil into millions of particles. Then follows the application of heat which further breaks down the oil particles into gaseous hydrocarbon. The third and last stage is the collision of the gaseous hydrocarbon with the air for combustion to produce finally the proper and complete air-oil mixture for effective combustion.

Engineers feel that there are many applications for this new principle of atomization.

Nature of Noise Influences Type of Corrective

By P. H. Geiger

INCORRECT application of the principles of noise correction easily may result in an amplification of the noise, according to Dr. Geiger, department of engineering research, University of Michigan, in this third article on the problem of divorcing noise from machines. Next month MACHINE DESIGN will present the methods employed by a number of machinery manufacturers in dealing with specific noise problems.

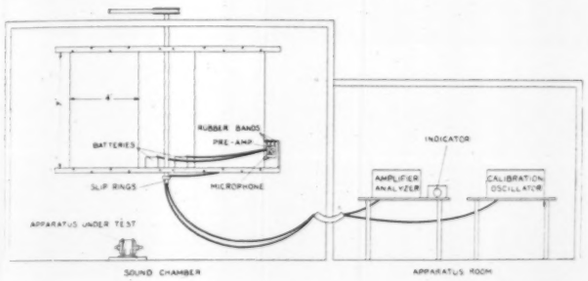

Fig. 1—Sound measuring apparatus for room use shown diagrammatically

HOW the designer may take advantage of the characteristics of the ear in order to to reduce machine noise depends on a variety of factors. As pointed out on page 20 of the July issue of MACHINE DESIGN there are several general methods of reducing noise. The principles upon which these methods are based will be discussed in turn in the following with the purpose of showing in what particular applications each is feasible. As with many other design problems, unless certain requirements are met, results may be had which are quite contrary to those desired. For this reason several common errors will be pointed out.

Flexible mountings which make use of rubber, cork, springs, or other flexible members often are used to prevent the transmission of vibration from one part of a machine to another or from the machine to nearby structural members. Such mountings are effective in reducing noise because they cut down the area of the vibrating surface thereby reducing the radiation of sound.

The best location for the flexible mountings, as well as their physical characteristics, is determined by the nature of the noise to be suppressed and the size of the parts. It is important to locate the flexible mountings in a position such that the vibrations, which produce the sound to be suppressed, are confined to parts of the machine having dimensions that are small in comparison with the wave length[1] of the sound. This is true because a given surface is relatively ineffective as a radiator of sound when its dimensions are small in comparison with the wave length. If any part of the machine is suspected of being a source of noise, the frequency usually may be calculated in the manner described in the discussion of Fig. 6, (page 23, July 1 MACHINE DESIGN). Any single phase induction motor is a source of vibration of

[1]The wave length of a sound, expressed in inches, is approximately equal to 13,000 divided by the frequency.

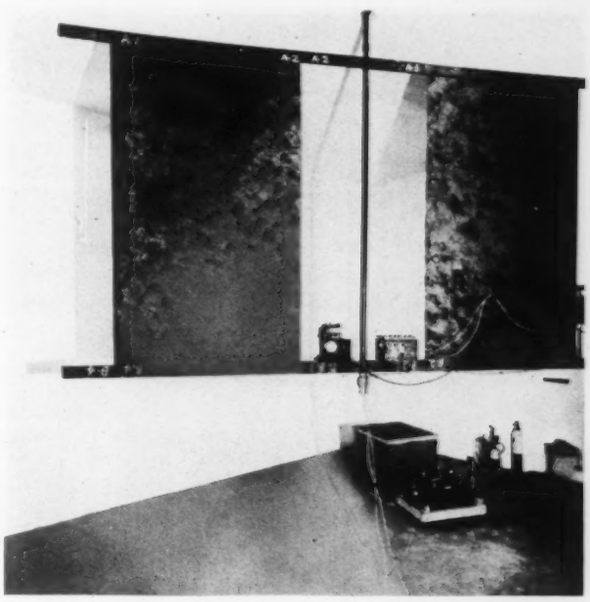

Fig. 2—In order to break up the standing wave pattern in the room, the two large vanes are rotated whenever measurements are being taken

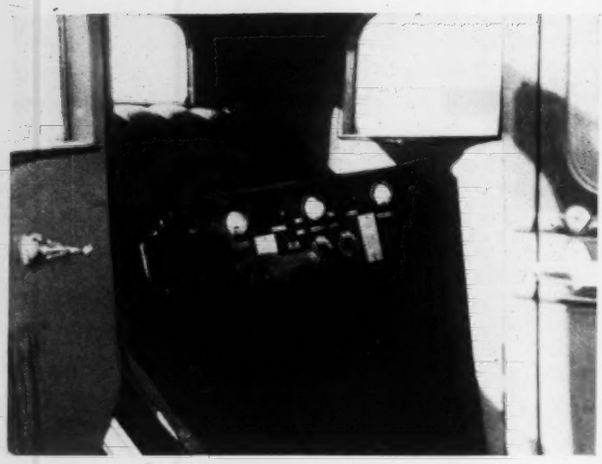

Fig. 3—Portable sound measuring equipment, with frequency analyzer, used for road test of automobiles

twice the frequency of the power supply. In cases where vibrations are generated directly in parts which are effective sound radiators for the corresponding frequency, flexible mountings are practically useless.

Examples of cases such as this often are found in motors. Sounds generated by the passage of the rotor slots past the stator usually are of comparatively high frequency, so the stator and frame of the motor often is a good radiator for that tone and so the sound radiated will be reduced only slightly when the motor is mounted on flexible supports. This accounts for the experience of many who have found that the "whine" of a motor still persisted when flexible mountings were used.

Damping May Amplify Sound

There is another feature in the design of flexible mountings which must be followed, otherwise the designers may be surprised to find that his mounting acts as an amplifier instead of an attenuator of sound. Whenever a mass is mounted upon an elastic member, the combination has a natural frequency determined by the stiffness of the mounting and the mass of the suspended body. If this natural frequency is the same as the frequency of the vibration to be suppressed, the force transmitted to the main body of the machine, or to the supporting members, actually is greater than it would be if a rigid mounting were used. Any vibration of frequency less than the natural frequency of the suspended system will be transmitted at least as well as it would be if the flexible mounting were not used. It is evident then that the natural frequency of the system must be less than the frequency of the vibration to be suppressed.

The desirable ratio between the two frequencies of course depends upon the amount it is desired to attenuate the vibration; the greater the ratio the better will be the results, as is shown in Fig. 6. This curve indicates how the amount of sound which is generated by a periodic force in a flexibly mounted member and which is radiated from the base and frame of the machine, is affected by a change in the elastic constants of the flexible mounting. It will be observed that there will be no cushioning effect unless the natural frequency of the suspended system is less than 0.707 times the frequency of the undesired vibrations. The curve was computed on the assumption that the damping was negligible. In this connection it might be remarked that a reduction of 50 per cent in the amplitude of vibration corresponds to only a six decibel change in loudness, as will be seen by applying equation (1) (July issue). The natural frequency of the mounted body can be calculated by the use of the following equation:

$$f = \frac{1}{2\pi}\sqrt{\frac{s}{Mg}} \qquad (2)$$

where s is the stiffness (pounds force per foot displacement), M is the mass in pounds, and g is the acceleration due to gravity (32.2 ft. per sec. per sec.). This equation was derived upon the assumption that the mass of the body upon which the system was mounted was large in comparison with the suspended mass. It should be remembered that a mounting is apt to permit several modes of vibration, probably of different frequencies, so care must be taken to insure that the highest natural frequency is not too high.

Fig. 4 illustrates a change made in the flexibility of a mounting block in order to preclude the possibility of the natural frequency of the suspended system coming near the frequency of a generated force. *A*, in Fig. 4, shows the cross section of a rubber motor mounting block used on Frigidaire compressors. Due to slight variations in production, the natural frequency of the suspended system on a certain model occasionally would come near the torque plusation frequency of the motor. This resulted in a comparatively large number of rejections, on this one model, when inspected for noise. On making the two cuts in the rubber block as shown in *B*, the inspection losses were reduced greatly.

In designing a flexible mounting it should be remembered that the advantages of the mounting may be lost due to conduction along some other paths, such as pipes, tubes, or wiring conduit. Belts are poor conductors of vibrations so they may be used.

Sufficient Damping Is Required

Just as a system composed of a mass suspended on an elastic medium has a natural frequency, so has any system in which a deflection calls out a restoring force. When any vibration produced by a machine coincides in frequency with the natural frequency of any part, vibrations of large amplitude are built up, with a consequent increase in the sound radiated. Since the ampli-

tude of the vibrations is built up until the power dissipated by the motion is equal to the power put into the vibrating system, large amplitudes are reached unless there is sufficient damping in the system to change the energy of motion to some other form of energy. The production of sound represents a damping effect, but it is the kind of damping which must be avoided, for a small amount of sound energy corresponds to extremely loud noise.

Any method of converting the energy of motion to heat energy is highly desirable. The placing of the vibrating body in a viscous fluid would be quite effective but often would not be practical. Frequently the resonating part can be made of a material which has a greater amount of internal friction than the material of the original part. It sometimes is practical to damp out vibrations by constructing the resonating part from two pieces, perhaps of different materials, in a manner such that any vibration will result in a relative motion between the two pieces with consequent friction.

If a suitable damping device cannot be found,

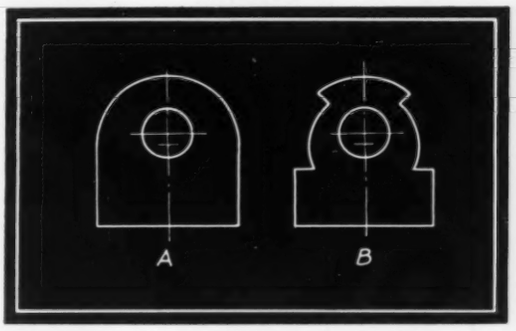

Fig. 4—A slight modification in the shape of a rubber mounted support greatly reduced the transmission of vibrations due to torque pulsations

the resonating part may be altered so that its natural frequency is different from any of the possible exciting frequencies. This remedy is comparatively easy to apply in the case of a machine operated at constant, or nearly constant, speed because the exciting frequencies then are quite definite and constant and consequently frequency ranges can be found where there is no possibility of resonance excitation. In the case of variable speed machines this remedy cannot be applied as easily because most of the exciting frequencies will vary over a range corresponding to the range of speeds and it perhaps will be difficult to find a value of frequency such that resonance will not be excited at some certain speed of the machine.

It may be difficult to raise the natural frequency to a high value without going into excessive weight, because the frequency increases only as the square root of the stiffness factor. Also, any method of increasing the stiffness factor is apt to increase the mass, which in turn tends to decrease the natural frequency. By using reinforcing ribs, or some other strengthening means which will add only a small mass, the desired frequency usually may be reached. In other cases it is necessary to adopt a material which has a different elasticity and density.

Since a vibrating system can be excited by shock excitation, it may amplify impulsive sounds, such as "knocks" produced by reciprocating parts. The ear cannot be trusted to detect the damped vibrations thus excited because to the ear they usually appear only as an increased loudness of the knock. In case sound measuring equipment is not available the detection of such sources of noise is extremely difficult. Probably the best procedure is to stop all possible causes by temporary means and note the effect upon the loudness of the knock. Any part of the machine which "rings" when struck should be suspected as a possible noise source.

Ear a Poor Test Instrument

Two characteristics of the ear make it a poor instrument for this test; first, the ear cannot be relied upon to remember the loudness of sound to within five or ten decibels; second, if all the possible sources are not stopped effectively for the test, the loudness will not be altered greatly due to the logarithmic response of the ear. For example, two equal sources of sound represent a loudness only three decibels[2] greater than one of the sources alone; four equal sources are only six decibels louder than one; eight sources are only nine decibels louder than one. Suppose there are five or six sources which contribute to the loudness of a knock by reason of shock excitation, and in performing the test outlined above one of these sources is neglected. It is quite possible that the resulting change in loudness would not be detected even though a desirable reduction would have been noted if all of the sources had been stopped.

Fig. 1 in the July issue shows that the loudness of a noise component of constant acoustic pressure varies greatly with frequency. In some instances advantage of this fact can be

[2]The chart shown on page 13 of the June issue of MACHINE DESIGN will give a concrete idea of the loudness scale.

Fig. 5—Changing the shape of a field pole tip slightly, reduced the magnetic tone developed by a suction sweeper

taken in designing a machine by constructing the rotating parts so that the frequency of a troublesome noise component is increased or decreased to a value lying within a region of comparative insensitivity of the ear. Sometimes a frequency change can be made which will increase the effectiveness of flexible mountings or decrease the sound radiating efficiency of a given surface.

Fan or blower design furnishes a well known example of the effect of frequency change. By decreasing the speed of the fan and the number of blades, the frequency of the fan tone is

Courtesy General Electric Co.

Fig. 5—Vibrations are picked up for the audio meter by use of this apparatus

decreased and the loudness thereby decreased, even though the fan blades have had to be increased in size to give the desired capacity. The decrease in frequency of the fan tone is by no means the sole cause of the noise reduction, but it usually is an important contributing factor.

Applying Sound Absorbing Material

Sound absorbing material often may be used to advantage in solving a problem of noise reduction, either by its introduction inside the housing of a machine or by its use on the surfaces of the room where the machine is installed.

In order to make the most effective use of absorbing material there are several facts to be kept in mind. A given amount of material is more effective when placed in a region of great sound intensity than when placed in a more quiet location. Different materials vary widely in their effectiveness over the audible frequency range. It is of course advantageous to adopt a material which has a high sound absorbing coefficient for the frequencies most prominent in the noise of the machine being quieted. Satisfactory absorption of sounds of low frequency is difficult to attain. This explains why the addition of absorbing material to a machine using an induction motor often seems merely to change the noise from a comparatively high pitch to a low pitch.

A common method of reducing noise is the reduction of production tolerances for moving parts. This generally is effective, but also sometimes quite expensive. This fact is evident when it is realized that defects in rotating parts of a few millionths of an inch can be the cause of a noticeable noise. Before the designer insists upon close tolerances, he should see if some cheaper means can be found to accomplish the results. Sometimes changes can be made in the lubricating system to take advantage of the damping or the cushioning effect of oil. Establishment of tolerances is of course an individual problem for each type of machine and for each manufacturing plant and so cannot be treated effectively here.

A common source of noise, especially in high speed machines, is unbalance in the rotating parts. A noise analysis readily shows the relative importance of this noise, for an unbalanced condition produces tones having frequencies equal to the speed expressed in revolutions per second and integral multiples thereof. A rem-

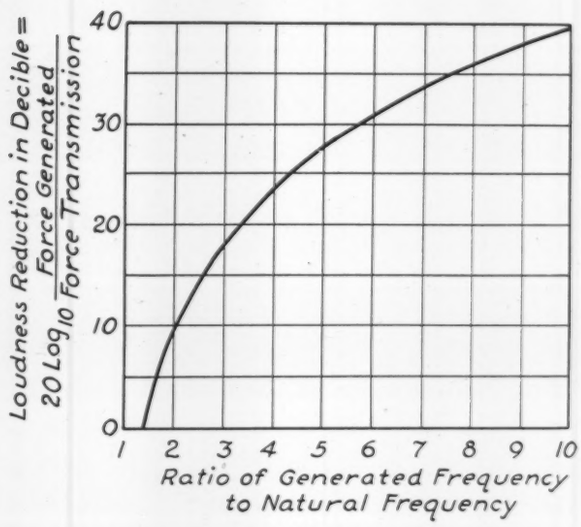
Loudness Reduction in Decible = 20 Log10 Force Generated / Force Transmission
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10
Ratio of Generated Frequency to Natural Frequency

Fig. 6—Effect of altering flexible mounting stiffness

edy for out-of-balance noise is obviously the adoption of a method of dynamically balancing the rotating parts.

In addition to the general methods of noise reduction described in this article, other solutions for individual problems may be found. Usually the greatest difficulty in solving a noise problem comes in determining the cause of the noise. After the cause is found, the effect of various changes can be studied. Fig. 4 shows how the engineering department of the Hoover Co. solved a specific noise problem. When the shape of the field poles on one type of motor was changed from that shown in sketch *A* to that shown in sketch *B*, a loud magnetic tone was reduced to inaudibility. Other examples of practical solutions of noise problems will be published in the September issue.

New Theory of Lubrication Is Propounded

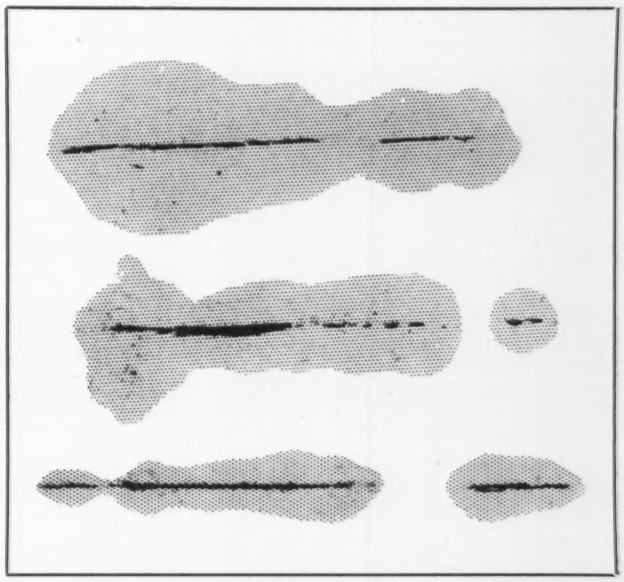

Fig. 1—Tests disclose that new oil film is formed after rotor has been initially wiped dry. Results obtained in second, third and fourth wipe are shown

DEVELOPMENT of a new lubrication theory has been made possible by discoveries of startling features in the behavior of lubricants. These in turn have been brought about through tests made on a new machine for investigating lubrication phenomena. Briefly, according to a preliminary report presented recently by W. F. Parish and Leon Cammen before the lubrication engineering committee of the American Society of Mechanical Engineers, a layer of oil is formed on the surface of metal, the thickness and strength of which are determined by the character of the lubricant and metal.

The layer of lubricant pumps oil into the crevices of the metal under pressure. In the course of contact with the bearing surfaces on the journal and the brasses the free film plays no part as a means of separating the surfaces of the metal. This separation is accomplished by the newly discovered adhering layers of lubricant, and when these are wiped off in the course of operation of the bearing they are restored immediately by the oil ejected from the crevices in and under the metal surfaces.

Factors in Lubrication Process

In order to understand completely the true mechanism of lubrication, the authors aver, it first is necessary to break up the act of lubrication as occurring in a machine bearing into its elementary components. These factors are (*a*) the film of oil as related to the shaft; (*b*) the film as related to the bearing; (*c*) the liquid film of oil between *a* and *b*; (*d*) the adsorbed film on the shaft; (*e*) the adsorbed film on the bearing. The adsorbed film is formed by condensation of gases in the atmosphere and exists on all surfaces.

Logically, in the proper study of one factor only, that one must be isolated from others with which it it combined in its functional relationships. Therefore, a lubrication testing machine was employed by Messrs. Cammen and Parish that would permit dealing with one factor of lubrication at a time. It was necessary to design the machine in such a way as to make it possible to run the rotor speeds from 1000 to 18,000 revolutions per minute without producing detectable vibration. A number of other features were developed, such as a method of taking samples of the oil as thrown off the rotor, control of temperature of the rotor, control of the atmosphere in which it spins, etc.

The original theory propounded by Irving Langmuir set forth that when a metal element such as a shaft or bearing is lubricated with grease or oil, a layer is formed on the surface of the metal which consists of a chemical compound made up of metal and oil. If this theory is correct, that the formation of a monomolecular oil metal layer is on the surface of the shaft, this presumably precludes any further chemical activity between the oil and the metal on the shaft.

Trillat and Woog and Sir J. J. Thompson have shown that at the boundary of the shaft there exists an electrical or magnetic field which holds the lubricant to the metal. There is here no implied disagreement with Langmuir. However, experiments with the new tester have shown that the thickness of the layer of oil that is power-

fully attached to the surface of the metal is considerable, many thousand times the thickness of a molecule. It also has been observed definitely that the layer is not "welded" or static as apparently understood by other investigators, but is altogether mobile and endowed with a certain amount of elasticity.

The report advances a new theory in regard to the fluid film outside the Langmuir layer, by the assumption of further existence of a magnetic or electrical field holding the oil to the metal. These fields probably obey the laws of Coulomb, by virtue of which their intensity varies inversely as the square of the distance. The layer of oil in the immediate proximity of the Langmuir layer therefore is held powerfully, while those farther away are attached more lightly, with the result that as the speed of rotation of the Sperry tester increases, particles from the layer farthest away are torn off, the particles becoming smaller and smaller with the increase of speed.

Size of Drops Change with Speed

Outermost layers fly off in relatively large drops; then as the surface of the Langmuir layer is approached the field that holds them increases in intensity with the result that it takes more centrifugal force to tear them off. This is illustrated in the reproduced photographs of records of the drops, Fig. 2. The three records show the relative size of drops at various speeds with castor oil on a bronze rotor. It will be noted that their size grows smaller as the speed is increased, the records, commencing with the one at the extreme left, showing results when the rotor turned at 500, 3000 and 6000 revolutions per minute, respectively.

When the innermost layer was reached this true boundary film was not thrown off the rotor even though speed was increased several thousand more revolutions. Experiments with the testing machine have shown that after the stage has been reached when further increases in the speed of rotation of the rotor do not produce a centrifugation of the lubricant, there is, nevertheless, a film on the rotor as indicated by the fact that it can be wiped off by a piece of folded bond paper, Fig. 1.

The remarkable part of it is, however, that after the film thus has been wiped off and the rotor presumably is dry, a new film is formed on the surface of the rotor, being supplied by the adsorbed oil. This new and second film is less in amount than the first and varies slightly from it in character. When it is removed by wiping off, a third and still smaller film is formed until at times as many as six or seven and in one case 21 such films have been reconstructed after the ones preceding have been wiped off.

These adsorbed films have been designated as Parish layers, consisting of oil contained in the metal under certain conditions. In Fig. 1 is shown the second, third and fourth wipe taken after the rotor reached 600 revolutions per minute. Castor oil on bronze was used in the test. The authors point out that regardless of how well the surface of the metal of a shaft or bearing may be finished, it is full of interstices of various dimensions from miniature cracks induced by strains in cooling from the molten state or shocks in machining of the metal, to the microscopic spacing between the grains and the submicroscopic cavities within the grains and the containing matrix.

A factor of extreme importance in the mechanics of lubrication is the fact that the shaft in a machine bearing never rolls truly but always slightly drags, this being due to a certain amount of eccentricity and load of the shaft. Dragging of the shaft acts on the Coulomb and Langmuir layers in the same way as wiping the rotor with the folded paper in the tester. Not only are the layers reconstructed instantly but the powerful pressure under which the oil is contained causes a lifting of the shaft away from the bearing. In this way, all proper lubrication is pressure lubrication.

Lubricants Made Up of Two Parts

Other tests on the new machine have given a basis for serious intimation that lubricants in general consist of two parts: One performing the functions of the lubricant; and other acting as colloidal solvent thereto. If viscosity has any bearing on the lubricating properties of the oil, it is only the viscosity of lubricating constituents of the lubricant and not the diluent constituent.

The authors state that this report is of a preliminary nature and will be supplemented with further developments from time to time.

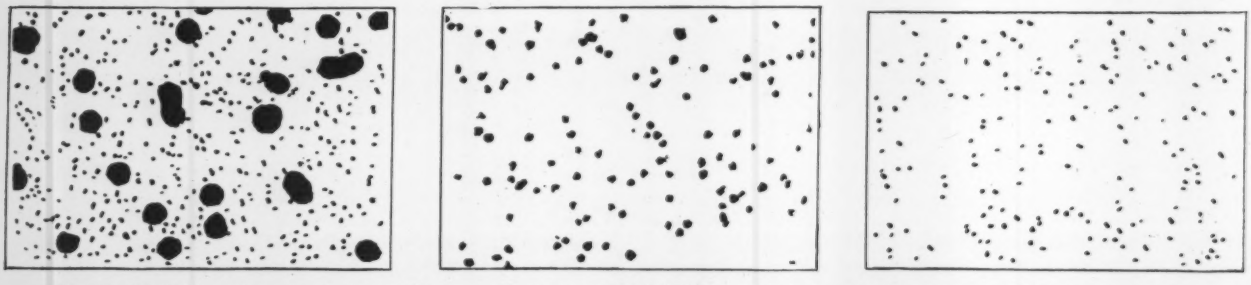

Fig. 2—Relative size of oil drops thrown off rotor at 500, 3000 and 6000 revolutions per minute respectively

IN last month's issue a number of design engineers expressed their opinion of engineering publications. They voiced annoyance at the large number of periodicals, the apparent overlapping of their editorial functioning and the difficulty of selecting the right magazine for their needs.

The accompanying article represents a sincere attempt to state the editors' viewpoint and to suggest several yardsticks by which engineering magazines may be judged by their readers.

Instead of a composite letter, we present this month a letter from a veteran editor (not identified with Machine Design), who comments on certain types of readers and offers constructive suggestions.

—The Editors

Bringing Technical Information to the Engineer's Doorstep

By L. E. Jermy
Editor, Machine Design

THROUGHOUT this series of articles it has been shown that in the majority of cases failure of design engineers to take full advantage of their opportunities lies in lack of understanding. Just as this was apparent in engineers' relations with sales, operating, management and purchasing personnel, it also is true in their attitude toward technical publications.

In last month's issue the composite letter by design engineers indicated that they are somewhat puzzled by the multiplicity of publications and find it difficult to select those few that are best suited to their needs. In this brief discussion we shall try to explain why engineering periodicals are so numerous and to offer suggestions as to how to judge the value of publications intelligently.

That the complaint that there are "too many magazines" is well founded is evidenced by the fact there are about 1800 business papers in the United States. Of this number, probably not more than one-sixth or 300 can be rated as worthwhile, responsible and rendering real service.

Engineers will ask, "How do the other 1500 exist; how can they continue long if they are not fulfilling an actual need?"

These are fair questions. One answer is that the leading publishers have not yet succeeded in giving industry an adequate yardstick with which to differentiate worthy from unworthy publications. Proof of this is found in the almost unbelievable gullibility shown by industry not only in patronizing periodicals of doubtful standards but also of lending them prestige through editorial contributions.

For instance, an outstanding figure in a certain branch of engineering has contributed liberally of technical articles to a publication which has practically no standing in its field except that which has accrued through the regular appearance of this expert's articles.

In a small field in which three above-the-average publications already had been giving excellent service, a fourth periodical was launched about a year ago. Although the publisher (who also was advertising manager, editor and circulation manager) had had no previous publishing experience and knew practically nothing of the industry which he was about to serve, several nationally known industrial advertisers took space in the first issue published. One possible explanation is that prior to soliciting space the publisher had persuaded an eminent engineering authority to contribute articles for the new

magazine. Perhaps the company representatives assumed that if the reputable engineer had promised to write for the periodical, it must be all right.

The foregoing are but a few of many true instances indicating that more than a few individuals in industry and in engineering do not know how to rate business papers on merit. They also serve to explain why there are more publications than are needed. Parenthetically it may be said that some of the executives who complain most bitterly that there are "too many papers" are the first to jump aboard the bandwagon of a new and irresponsible publication.

Much of the evil resulting from confusion as to relative merit of business papers can be eliminated if industrial executives, engineers and others interested will heed these suggestions.

First, consider each publisher as one who has received from an industry or an engineering profession a franchise to serve it adequately through the medium of his publication.

Second, consider yourself a representative of the industry or profession empowered to grant or withhold the franchise according to the publishers' ability to render a required service. Test the publication's performance or ability to serve by the following or similar questions:

What I Think About Readers an

OUT OF an experience of many years as an engineering editor, I feel that I can speak with some authority on the value of the proper relationship between engineers and engineering publications. The potential benefiits never have been fully realized and will not until editors and subscribers understand each other's problems more thoroughly.

Ability of an editor to present in the pages of his magazine the information suited to the needs of its readers depends in a large degree upon the scope and quality of his acquaintanceship with representative individuals in the industry or profession which his publication serves. To be successful the editor and members of his staff should be in the confidence of many of the leaders in the field and should have numerous other wisely distributed contacts.

These are not necessarily for the purpose of securing material for publication; more often than not the most important information that can be obtained by an editor is that which never appears in print. It is the mass of fact, fancy, opinion and conjecture which assembled, correlated and analyzed gives him a background of working knowledge.

Many engineers who have had close contact with editors of the leading publications realize this fact and consciously or unconsciously constantly are yielding valuable information. This is not a one-sided affair, because in most cases contacts with editors result in an exchange of facts and ideas which is mutually advantageous.

But not all engineers are won over to editorial co-operation easily. Some are extremely suspicious. Many are close-mouthed simply because they do not know the mechanics of publicity and are fearful of its effects. A few, who have had unpleasant encounters with newspaper reporters, are wary of editors of engineering publications. Now and then one finds an engineer who feels he has been dealt with unfairly by a business or engineering magazine and he is likely to bear resentment against all publications of this class.

In my experience I have found that in the majority of cases where co-operation with editors is withheld by engineers, the cause is lack of understanding of what the editor wants and of how he will use the information if it is imparted to him.

Occasionally in talking with engineers, I have been told

"An editor hears scores of 'stories'"

"Yes, I'll tell you about the situation, but don't quote me." When I hear the phrase, "don't quote me," I am almost certain that I will not hear anything from him worth quoting, even assuming that the information I desired was for publication.

On the other hand if in an interview my informant speaks freely on a certain project that is in process of development, I usually can tell whether or not it would be proper to publish anything on it. If it would be unwise to have the matter discussed publicly prematurely, my informant may or may not ask me to treat the information confidentially. Every editor hears scores of "stories" without pledge of confidence, which if published would cause much harm, but only rarely do such articles see the light of day.

Engineers should remember that an editor of a reputable professional publication cannot violate a confidence more than once and get away with it. His very success is built on confidence. Once he loses the trust of those who cooperate with him his usefulness is gone; he is through!

Looking at the relations between engineer and editor purely from the standpoint of the former, there is much to be gained by frankness and confidence. For illustration, assume that two companies are working on developments of extreme interest to the industrial world. The fact that the work is in progress is known rather gener-

1. Is it published by a responsible individual or company?
2. Is it rendering a necessary service?
3. Is it exerting a constructive influence?
4. Is it doing a good job editorially?
5. Has it an adequate editorial staff (number of editors, experience and ability)?
6. Are its editorial pages free from "trade puffs," commercial propaganda and other evidences of "cheap" publishing policy?
7. Does it present high-grade editorial material, with a fair percentage of original articles (as compared with "hand-outs" and second hand material picked up from other publications).
8. Do leading authorities contribute articles for its pages?
9. Does the editorial text seem to ring with authority?

If the answers are preponderantly in the affirmative, you can rest assured that the publication is worthy of your confidence and co-operation. If many of them are negative you will do well to investigate carefully before contributing articles, or co-operating in other ways.

The best criterion of an engineering paper is the job it is doing. When this fact is generally realized throughout the engineering profession there will be fewer, but better publications.

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and Writers—By an Engineering Editor

ally—at least among those well informed of what is going on. The editorial men of the various interested publications go to these companies to get a line on the probable significance of the work. Assume that the spokesman of one company is unwilling to give out anything that would be helpful to the editors in determining the importance of the development, while the contact man for the other company explains the proposition frankly but tells his interviewers that the details will not be available until later. When the time comes for publication of the results of these developments the company with the policy of liberality and frankness will be accorded intelligent editorial treatment, whereas the company with the close-mouthed representative will be extremely disappointed because the editors will have appeared to have underrated or misunderstood the significance of its work.

Many engineers contribute articles to engineering publications. Reputable magazines pay a fairly good rate for such contributions, but the compensation usually is not as important to the contributor as the intangible rewards that go to those who create the literature of an industry or profession. The writer believes that publications should pay liberally to encourage engineers to voice their opinions and the results of their work. On the other hand, I have noted that when an engineer permits the matter of remuneration to gain ascendency over the other aspects of his writings, he usually deteriorates into "hack" writer.

"Material often takes months to collect and correlate"

The quality of his contributions drops noticeably and his urge for volume (and therefore income) carries him into carelessness, superficiality and other faults.

My advice to engineers who write for publication is that they guard their reputations carefully. Do not lend your name to "cheap" publicity. Do not permit your writings to appear in any but the most reputable publications. Never allow your name to be associated with a "stock-selling" proposition unless you are willing to stake your reputation on its merit with full knowledge of all pertinent facts regarding it. Do not fall victim to the fascination of journalistic work to the extent of neglecting your regular duties. Maintain a sound sense of balance.

Many engineer authors fail to appreciate the fact that the amount of research and effort put into an article is not a true indication of its value or usefulness. I have seen scores—perhaps hundreds—of manuscripts to which the authors had devoted months of painstaking work but which were of interest to such a limited number of persons that no publication could use the material. This is as true of technical books as it is of articles intended for periodicals.

Time and time again engineers have approached editors with complete manuscripts only to be met with the advice that the work is not suitable for publication. Sometimes this is because the text covers ground that already has been fully dealt with by numerous other writers. In other cases the text matter is far more academic, detailed and exhaustive than is warranted by the general importance of the subject treated.

Engineer authors can guard against futile journalistic effort if they will investigate the possible use of articles before carrying them through to completion. Every editor welcomes the opportunity to discuss ideas for contributions. Sometimes he is able to make suggestions that will slightly alter the angle from which a subject is discussed and in doing so enhance the value of the article. Very often he can warn the author against going ahead with work which cannot be published. In any event the engineer cannot lose anything by consulting one or more editors before his work is completed and he may gain valuable advice.

In conclusion let me urge you to co-operate with editors and with engineering publications. You will find that it will be profitable.

Protecting Bearings with Unit Oil Seals

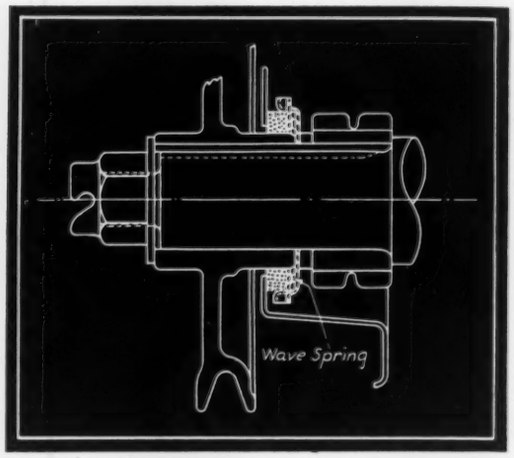


Fig. 1—Seal which rotates with the shaft is kept tight through action of a wave spring

BEARINGS starved of lubricant or attacked by foreign substances cannot function properly. This known fact, one that has caused designers to spend long hours assuring proper packing, is a troublesome factor in machine building that manufacturers are combating by the application of unit packing glands, self-contained oil and grease retaining parts which may be specified and installed without the necessity for detailed design. Modern mechanical standards, requiring the utmost in efficiency, endurance and economy in the design and operation of all types of machinery have been responsible for the success of these seals.

The oil seal is, in general, a compact unit with the metal retainer parts, spring or pressure plate, and packing fully assembled. Springs of various types, or the pressure plates, exert a uniform pressure, holding the packing to the surface on which it seals. Leather, cork and asbestos are employed as the packing members, with leather being used most generally; special tannages are selected, variations determined by the conditions under which the unit operates.

Methods of effecting a perfect seal differ in the manufacture of the various units that have been developed. One design depends on the natural resilience of specially treated cork and the pressure of a deflector plate to maintain the seal. Others are so designed that they rotate with the shaft being sealed, Fig. 1. These differences are accentuated in seals for use under special conditions such as water pumps and other water sealing applications, in which cases the units are equipped with special leathers and with all metal parts plated.

Design effect of the stationary oil seals, other than the elimination of the necessity for contriving the details of the device, consists of the provision of a counterbore or recess in the housing and the specification of tapers or chamfers on shafts or hubs assembled through the packing member or over which the seal is drawn. The seals are installed by simple press fitting operation, assurance of proper fit being given

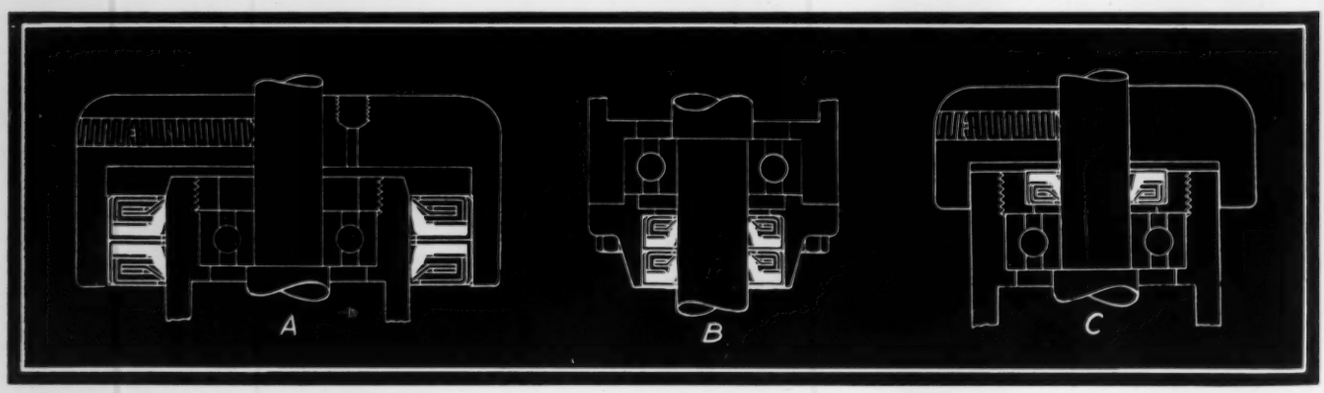


Fig. 2—A—Two seals, back to back, are effective in retaining lubricant and keeping out foreign matter. B—Piston ring arrangement aids in combating higher pressures. C—A cap is of assistance in keeping nominal dirt from the bearing

by specifying the machining of the recess to plus .002 above or minus .001 smaller than the low limit of the outside diameter of the oil seal assembly. This applies to diameters up to 3 inches. On larger sizes the bore should be machined plus .003 or minus .0015 above or below this limit.

Shafts or hubs on which the seal operates must be smooth, preferably ground, to insure leakproof running contact. Sharp edges or burrs damage the packing member. Light steel cones or tapered sleeves can be used to prevent the packing being cut by keyways or grooves in the shaft during operation. These same sleeves should be used when it is impossible to taper or chamfer the shaft or hub, for ease in mounting the unit.

Shaft Whip Limits Efficiency

Efficiency of seals which rotate with the shaft is controlled by excessive lateral motion, shaft whip and vibration. This type of seal, often used for the front end of engine and pinion shafts, brings up an entirely different design problem. These seals are manufactured either in a style similar to the stationary seals, keyed to the shaft, or have seals turned by friction of the parts and kept tight by a spring working

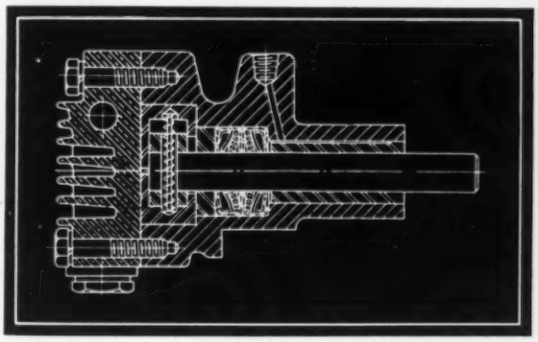


Fig. 3—Lubricant may be retained and abrasives kept out by back to back installation. Pressure plates replace springs in this design

against a rotating ring, Fig. 5, or a second seal. Suggestions for design of equipment using these seals, other than the provision of a chamfer on the hub or shaft, cannot be made general as they are affected considerably by details in the overall design. When the shaft runs eccentric the whole assembly goes with it. End play is limited to the throw of the spring.

Where the exclusion of dirt or abrasives forms an important problem, the seals may be applied with their wiping lip facing outwardly, away from the bearing, or two seals may be used, one facing each way, Fig. 2*A*. One manufacturer has brought out a special duplex seal that incorporates these two seals into one. Where two separate seals are used, and the speeds are high, a lubrication pocket should be provided between them as shown in Fig. 4. Slow speed applications such as road machinery wheels and agricultural truck roller equipment do not present as serious a grease leakage problem as they do an exclusion problem, so a single seal, with wiping lip facing outwardly, usually suffices. Good protection against nominal dirt, grit or liquids is given by a cap over the seals, Fig. 3*C*.

Each application of a unit oil seal is a separate problem and requires special consideration. It is of the utmost importance that com-

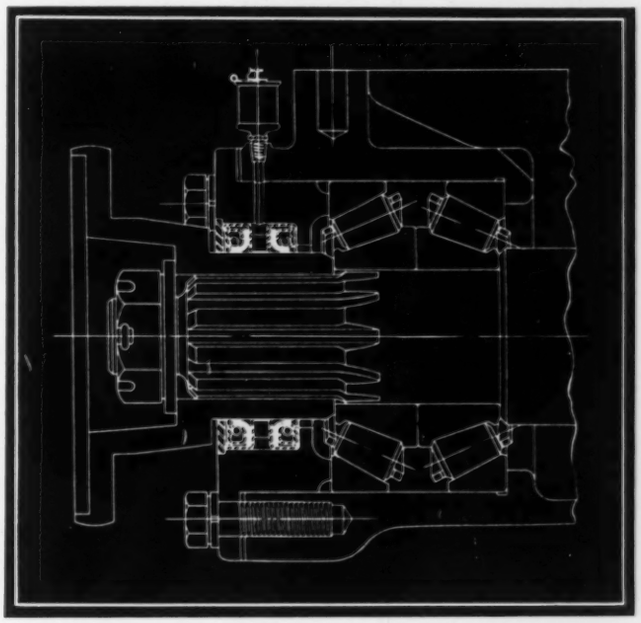


Fig. 4—Where two seals are used, best design suggests the use of a lubrication pocket between the two

plete details as to shaft speed, lubricant to be sealed, heat conditions and pressure, if any, be obtained before the selection is made. Both stationary and rotary seals, used as standard equipment by many manufacturers of washing machines, stokers, printing machinery, speed reducers, electric motors, pumps, farm implements and road machinery, encounter every conceivable set of conditions. Applications which appear to be unsuited to their use may be made practical by judicious alteration of some of the design details of the machine. An example of proper sealing under adverse conditions is found in the sealing of automobile pinion shafts, where despite shaft speeds of 1000 peripheral feet per minute, extraordinarily high temperatures and excessive oil pressures for the fast traveling differential gears, a seal is being used with marked success.

Peripheral speeds must be limited because of the increasing friction and the consequent development of heat. A number of manufacturers do not recommend seals for speeds over 1500 feet per minute while for speeds over 700 feet specially treated packing material is used. There

are many applications where the seal will function satisfactorily at higher speeds but, quite naturally, the frictional resistance is excessive and such applications are difficult to handle. These limits vary, of course, among the manufacturers, and in general it is the combination of conditions that governs the limiting factors rather than the peripheral speed alone.

Pressure that a seal will withstand depends a great deal on how tight the seal is gripped around the shaft. On some applications extremely high pressures are exerted on the seal when bearings are lubricated by high pressure grease guns. This is particularly true when seals are located in close proximity to lubrication fittings. In such cases it occasionally is found necessary to lock the assembly into place by means of a snap ring fitted into the groove just outside the seal. This is required only when lubrication pressures are extreme.

Piston Ring Arrangement Efficient

Another method of efficiently sealing against higher pressures is to specify two seals working in tandem, similar to piston rings, as shown in Fig. 2*B*. This is good practice for preventing leakage when the pressures are extreme. Pressure is a difficult factor to combat, because when it is applied against the seal a like amount is developed between the seal and the shaft, friction is increased and heating takes place. At slower speeds, of course, more friction can be permitted on the same seals. Another point to consider in the use of seals employing leather packing, is that when untreated leather is put under pressure it tends to carbonize and harden.

Temperatures up to 225 degrees are withstood by leather tanned and prepared by a special process without any charring or hardening of the packing member, although 200 degrees is considered the maximum for specification purposes. Quite often, where the seal receives a large volume of lubrication, not enough heat is developed to make the use of special leather an absolute necessity at 700 feet per minute or even 1000 feet, but a margin of safety is provided by selecting that point as a speed at which to change from regular oak tanned gasket leather to the special mineral tanned heat proof material.

Specially Treated Leather Used

Mineral oil, acids and alkalies are great detriments to leather, and even with the use of mineral tanned or chrome tanned leather, it is almost impossible to make a seal that will withstand acids, alkalies and other such fluids when using leather. Therefore, the manufacturers do not recommend seals for applications where acids or steam come in contact with the leather. For applications where the seal is exposed to water, specially treated leather is quite efficient. Manufacturers of pulp and paper machinery have found that seals protect their bearings from the excessive moisture to which they are exposed. However, marine engine applications often require the seal to be made with either stamped brass parts and bronze springs or with metal parts, cadmium plated. Such substitution of materials makes it possible to manufacture seals that will not be affected by the liquids held. Gasoline, naphtha, carbon tetrachloride and oils have been held back successfully by some types of standard packings.

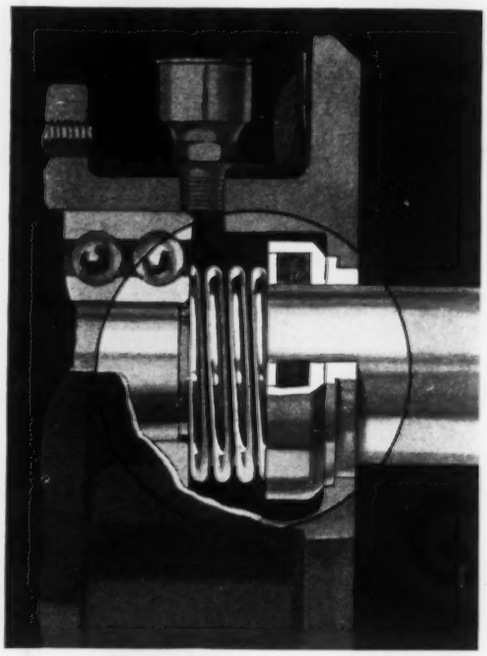


Fig. 5—Entire unit rotates with the shaft being sealed

With research on the design of unit oil seals progressing rapidly, it is conceivable that the upper limits placed on speeds and pressures soon will be raised considerably. Many shaft applications present a difficult sealing problem due to deflection or "whip," but this difficulty has been overcome by research that brought about the development of self-aligning seals which efficiently retain the lubricant. Seals now are being made for shafts from ½ to 12 inches diameter.

Other types and methods of packing, and packing materials, and how they are related to the designer's problem of retaining oil and grease will be covered in forthcoming issues of MACHINE DESIGN.

For assistance in the collection of data and illustrations for this article, MACHINE DESIGN wishes to acknowledge the considerate co-operation of the following manufacturers of oil seals: Aetna Ball Bearing Mfg. Co.; Chicago Rawhide Mfg. Co.; Gits Bros. Mfg. Co.; and Rotary Seal Co., all of Chicago; and Universal Oil-Seal Co. Inc., Pontiac, Mich.

Stamping Out Tradition in Casting Design

By F. A. Lorenz Jr.

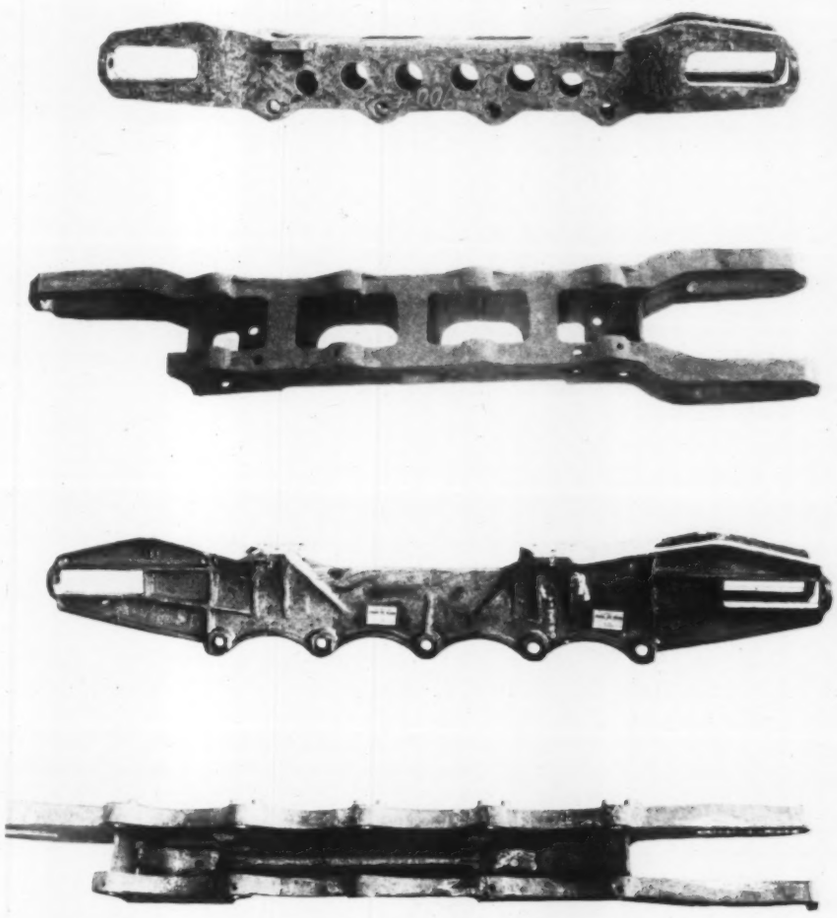


Fig. 1—(Upper two views)—Plan and elevation of original design of a casting the molding of which involved the use of complicated interior cores. Fig. 2—(Lower two views)—Design as revised permits the pattern to leave its own core when withdrawn from the sand

MANY of the designs produced today in cast steel have altered in no great degree from the essential features of their prototypes of the cast iron era. An examination of wood cuts and photographs of early machines will reveal the persistance with which empirical principles have carried down to our modern designs.

Steel in its cast form has suffered because of this inheritance, according to Mr. Lorenz, general manager, Industrial division, American Steel Foundries, who presented the paper from which this article is abstracted at the joint meeting of American Foundrymen's association and American Society for Testing Materials.

Steel castings lend themselves with facility to the varied necessities of design. The range of their application in industry indicates the dependence placed upon them. This range grows greater as the designer and the foundryman reach a better understanding of their related problems and as the objectives of the one are conditioned to meet the facilities and technique of the other.

To the design engineer belongs the initiative in bringing about co-operation between himself and the foundryman. Originating in his mind, the design is developed and ultimately presented to the foundryman for his quotation of price. Too frequently the design is developed with no great consideration of changes which might reduce the cost of production or of modifications which would improve the ability of the casting to withstand the stresses imposed in service. These are important considerations, and much benefit may be gained if the broad fundamen-

tals of steel founding are understood by the engineer, or if he will avail himself of the information which a steel foundryman can give as the design is in process of development. It may not be an exaggeration to state that it is as essential in developing a design to understand the characteristics and behavior of steel in the mold as to know its characteristics and behavior under working conditions.

Steel, as it solidifies, forms crystals, and the shell created by contact with the mold surfaces is of crystalline structure increasing in thickness as the temperature of the interior, due to loss of heat through the shell, reaches a point where additional crystals are formed upon its inner surface.

Crystal Formation Is Progressive

This formation of crystals also involves a contraction as the change from the liquid to the solid state takes place. The action of the formation of the crystals is progressive and takes place from all directions toward the center.

A method of providing sufficient radiating surfaces to effect a uniform cooling rate is shown in Fig. 3. The casting was molded in the vertical position, with the ring up. The two views indicate the ways in which the members were relieved by openings, while sharp corners were eliminated. The result was a component of a machine which combined lightness of weight and great resistance to service stresses. Serious strains were not induced in the solidification of the steel because the design accommodated itself to contraction phenomena.

Shrinkage Influences Costs

Shrinkage or contraction concerns the designer largely because of its influence on the cost of castings. The foundryman must take into consideration the expense entailed by the precautionary steps in producing a casting free from cracks and cavities caused by shrinkage or contraction. Many safeguards of practice are applied successfully for this purpose in addition to normal production methods, but they necessitate extra manufacturing expense. The designer, either through his general knowledge of the behavior of the metal in cooling, or through information obtainable from the foundryman, can assist greatly in obtaining a satisfactory casting at a reasonable cost.

The two views of the casting shown in Fig. 1, show the original design of a piece, the molding of which involved the use of complicated interior cores. These cores necessitated not only elaborate and expensive core box equipment but required special attention in their production. They required a special sand mixture and extreme care in setting the cores in position in order to avoid the cracks which were prone to appear as the metal contracted over the cores. These precautions added to the cost of production and retarded the progress of the castings through the shop. The redesigned casting, shown in two views in Fig. 2, eliminated the use of interior cores, and permitted the pattern to leave its own core when withdrawn from the sand. Cores were required to produce the brackets and ribs on the exterior, but the equipment was simple and the cores were produced at a much lower cost than the interior cores of the other design. Difficulties from cracks were eliminated, for the contour of the new design lent itself to self-adjustment in cooling, and in general proved a decided improvement over the old construction.

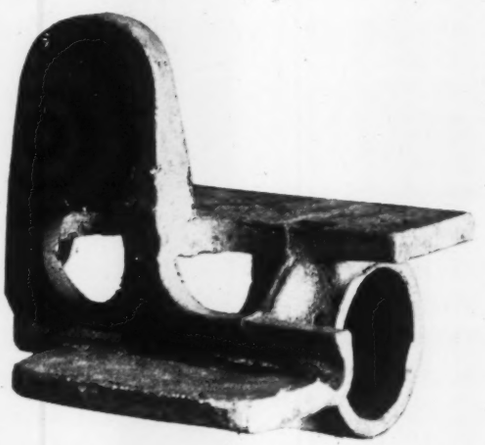


Fig. 3—Sufficient radiating surfaces to effect a uniform cooling rate were obtained by redesigning the casting shown above to the section shown below

Metallurgically, the modern steel foundry has made significant progress. Research laboratories have met anticipated demands by developing new alloys of outstanding merit. Unfortunately, inadequate contact between the designing engineer and the foundryman has prevented application of information gained by the advances which have been made.

Industrial Leaders View Research

"Profitable Practice in Industrial Research;" Reviewed by Harold B. Veith

GROWTH of the number of commercial industrial laboratories in this country from less than 500 to 16,000 in the last 10 years is indicative of the prominence research is assuming. Intelligently applied, it is a basic factor in our civilization and progress depends on it. With the increasing number of laboratories there is a need for guidance among the organizations just undertaking research work, hence the consummation of the new book, *"Profitable Practice in Industrial Research."*

For the enterprising designer the volume offers an insight into development of his personal aptitude toward this type of activity. Listed at the bottom of the page are those who collaborated in the volume, chapters being written independently to cover various phases of the subject. Running through these various chapters there is a certain continuity of thought and reiteration of ideas concerning basic underlying principles.

There is little to which exception may be taken in this symposium. Some of the authors might be charged with generalization, but in the main it will be found that the contributors do not mince words. Consider for instance, what Charles F. Kettering has to say when he reviews some of the pitfalls to be watched in undertaking work of this nature: "Research is not a panacea for all ills of industry. If I want to stop a research project," says he, "because I think it is no good I can always do so by getting a few experts to sit in on the subject. They know immediately it was a fool thing to try in the first place. In qualifications for laboratory workers there is nothing quite so valuable as a certain amount of intelligent ignorance."

A research laboratory if it is to prosper, L. A. Hawkins declares, must grow gradually. Rewards for staff discoveries should be made in the form of salaries rather than bonuses; complete laboratory records are the best protection for patentable discoveries; research need not be conducted on an epic scale to yield rich manufacturing returns. These are salient points.

Growth of the small business depends upon its supply of ideas for new products and methods. Furthermore, the reader learns that co-operative research cannot take the place of a private laboratory. A well equipped industrial research department is in a far better position to develop inventions than is the individual. C. E. Skinner makes this statement. He advises taking engineers into the confidence of the laboratory, thereby enlisting their interest and help.

Although space limits exhaustive discussion of the various phases of research, virtually no aspect of the subject is omitted. The late Dr. George K. Burgess, director of the bureau of standards at the time of his death, revealed the widespread activities of that organization. He and other contributors to this book represent a brilliant cross section of those trail blazers who have made valuable technical contributions.

Malcolm Ross assisted by William Spraragen and Maurice Holland edited the volume. It is published by Harper & Bros., New York, and is available through MACHINE DESIGN for $4.00 plus 15 cents postage.

Distinguished Scientists and Engineers Collaborating in Research Edition

Charles F. Kettering
Vice president, General Motors Corp.

C. E. Kenneth Mees
Director of research laboratory, Eastman Kodak Co.

Charles M. A. Stine
Vice president, E. I. du Pont de Nemours & Co.

Dr. George K. Burgess
Director of the bureau of standards

Arthur D. Little
President, Arthur D. Little Inc.

William Spraragen
Secretary, division of engineering and industrial research, National Research council

Frank B. Jewett
Vice president, American Telephone and Telegraph Co.; President, Bell Telephone Laboratories

L. A. Hawkins
Executive-Engineer, research laboratory, General Electric Co.

Edward R. Weidlein
Director, Mellon Institute of Industrial Research

C. E. Skinner
Westinghouse Electric & Mfg. Co.

Willis R. Whitney
Vice president and director of research, General Electric Co.

Prof. Dugald C. Jackson
Massachusetts Institute of Technology

John Mills
Bell Telephone Laboratories

Maurice Holland
Director, division of engineering and industrial research, National Research council

Editorial

Alert Manufacturers Are Keeping Eye on Future Prospects

DESIGN chiefs who have gone through one or more depressions prior to the present one know from experience what to expect when business recovery gets under way. The engineering department may be called upon suddenly for information, drawings, estimates, etc., that will keep the force working at fever heat.

One chief engineer is anticipating this call to action by devoting a few minutes each day to going over projects that were dropped or held in abeyance after the crash of 1929. Already he has found two that are likely to be revived when business picks up. He is familiarizing himself with their details so that if and when he receives word to go ahead on them, he will be prepared to act promptly.

Another engineer, whose company figured on machinery involving about $100,000 in 1930, was instrumental in having the sales department check up on the possibility of this order being released soon after signs of business improvement are more convincing. The sales manager has discovered that the outlook for early awarding of the contract is favorable. The engineering department is all set to go and is believed to have several weeks advantage over competitors.

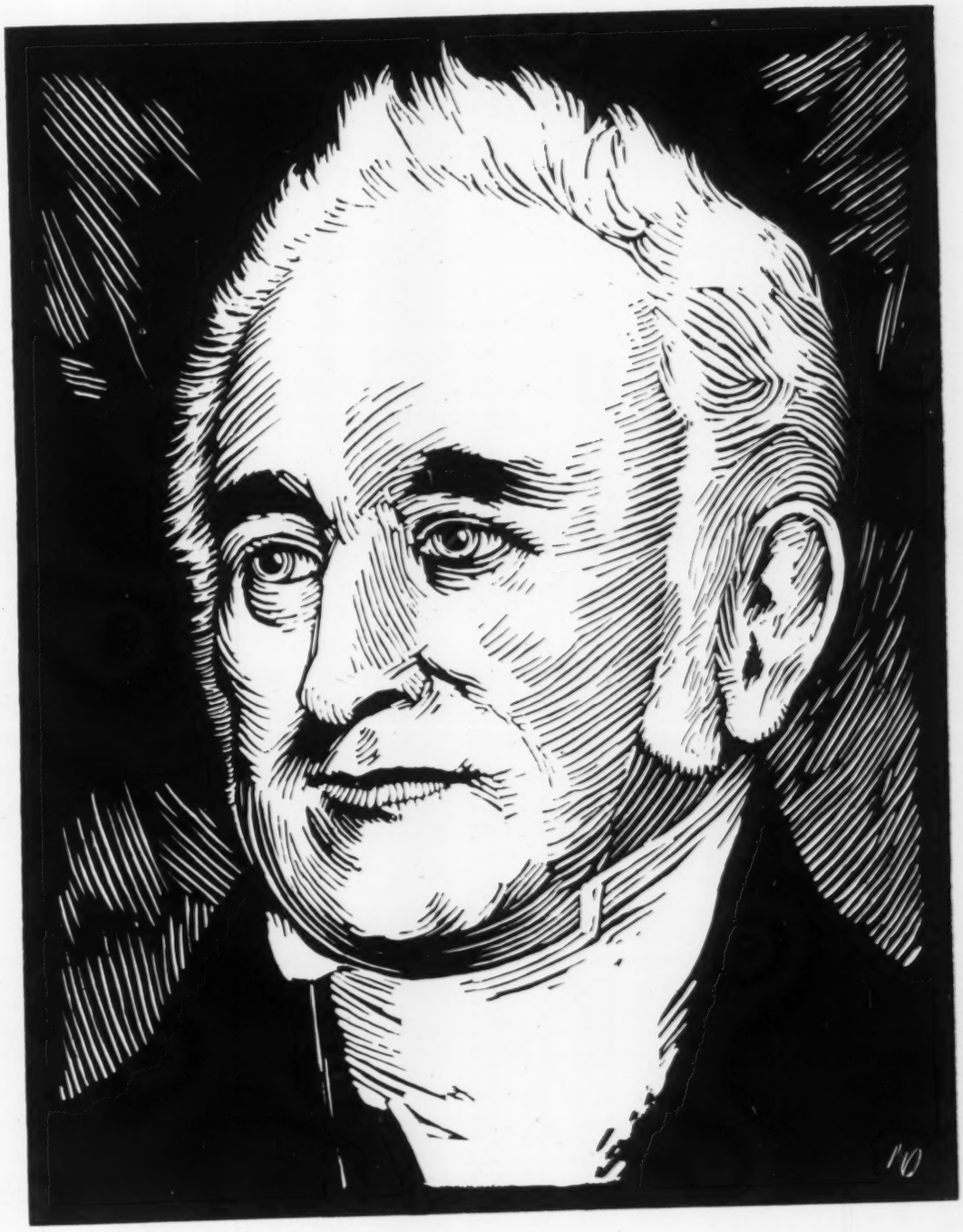
Alertness and preparedness will be important factors in design during the approaching period of rising industrial activity. Design engineers who plan and organize now to meet the inevitable demand for action will later be richly rewarded for their forehandedness.

The Cost Soars!

SEVERE criticism has been leveled at designers for failure to observe the rule that simplicity pays. A machine tool manufacturer states that the engineering department seems to have lost all sense of reason in the scramble to design machines that will offer the utmost in efficiency. New movements and accessories are added here, there and everywhere to certain models until in the end they begin to assume the aspect of a well-laden Christmas tree.

In the automotive field, Wm. B. Stout, vice president, S. A. E., recently belabored automotive designers for following too closely traditional concepts of design and declared that the addition of gadgets to cure inherent design faults is a fallacy on the part of so-called big executives . . . rather is it essential to review fundamental design for improvement.

There are times when an additional mechanism or part in a design pays big dividends. But to continue adding them proves the design basically unsound. Cost becomes prohibitive. It's better to sell a few simple, reliable machines than to sell none of the type that are capable of doing about everything but talk!



George Stephenson

Master Designers

George Stephenson

PERSEVERE! This one word of advice was the invariable answer of George Stephenson, the railway engineer, to his fellow workers when they seemingly were beaten. It was his recommendation to young men fighting to gain a place in the profession. And it was his desire to persevere that raised him from uneducated poverty on the banks of the Tyne in England, where he was born in 1781, to a foremost place among engineers.

STEPHENSON was not the inventor of the steam locomotive, but it was he who built the first commercially successful engine. He also laid out and built the first successful commercial railroad and it was only his enthusiasm and confidence in locomotives that brought about their adoption. The famous "Rocket" designed by Stephenson and his son won the open competition for locomotives to be used in this road, and locomotives with improvements by these two dominated the railroads for many years.

WHEN Stephenson was 14 he won a place as assistant fireman at a colliery. Later he was elevated to engine man and through studious application gained considerable local fame as an expert mechanic, among his achievements being the invention of one of the first practical safety lamps. He learned to read and write at 19, and spent many holidays taking apart and cleaning the hoisting engines, learning how they worked and studying the principles of mechanics.

HIS first locomotive, built to supplant horses at the colliery, was an immediate success, including as it did many of the basic principles employed in locomotive design today. This practical genius, whose charming personality gained him the friendship of everyone, obtained the post of engineer for the youthful, untried railroads, building them despite enormous odds and the antagonism of engineers. Stephenson never definitely retired, but before he died at 78, he was able to live as a country gentleman and indulge in his great love for animals and farming.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

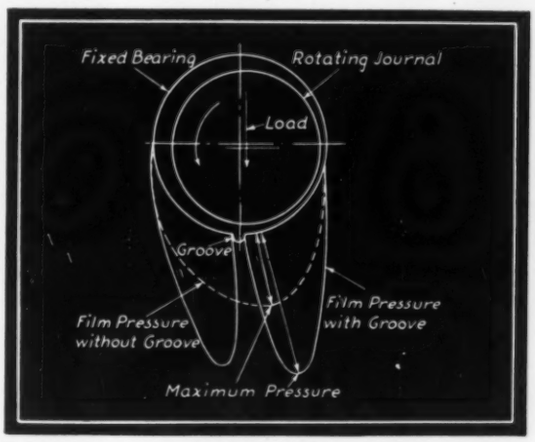
Comments and Questions from Our Readers. Machine Design Will Pay for Letters or Solutions to Problems Suitable for Publication

Oil Grooves in Bearings

To the Editor:

UNDOUBTEDLY lack of space prohibited a more extended discussion of grooving by Harold B. Veith in his article "Lubrication Should Be Considered In Machine Layout," appearing in the June issue. I believe, however, that a few additional comments might be of interest to readers.

In the accompanying illustration is shown the effect of cutting grooves in the high pressure area of a bearing. Assuming a fixed load upon the bearing, the broken curved line indicates the fluid pressure required in the oil film to sustain the load without an oil groove. The full curved line illustrates the fluid pressure required to support the same load with an oil film cut in the high pressure region. It can be seen that the maximum stress within the oil film is considerably greater with the oil groove than without. Hence the factor of safety against oil film rupture has been reduced materially. Under no



Oil film pressures developed in bearings with and without oil grooving

circumstances should a groove be cut in the high pressure region since it interrupts the continuity of the oil film, as indicated in Mr. Veith's article. It thereby decreases the load carrying capacity of the bearing and moreover acts as a drain to lead the oil away from the area where it is most needed.

The cross section of the oil groove is of great importance. Edges of the groove must be well rounded, or cut with a long taper to eliminate "scraping off" of the oil. Especially, care should be taken to avoid sharp corners when grooving is cut by means of a small hand chisel. V-grooving is objectionable because it may start a crack in the bearing lining and, furthermore, its capacity is less than a round bottom groove of the same width. Extra wide, shallow grooving destroys more of the bearing surface than is necessary and for this reason is undesirable.

—JAMES I. CLOWER,
Romney, W. Va.

A Benefit to Design

To the Editor:

I WANT to protest against your editorial under this title in the July issue, in which you advise students to continue in school a few more years because of present business conditions. Today many employers are dissatisfied with their organizations, which have shown themselves incompetent to meet unexpected emergencies. Probably more than ever before they are ready to turn out their executives. Many have dropped most of their staff already and are looking for a chance to replace them with new men. This offers an opportunity for this year's graduates that they are not likely to get a few years hence, especially in small companies where the new man can come in direct contact with all the executives.

There is one thing that stands in the way of most of these opportunities and that is the shortage of capital. Employers are on the lookout for the men but do not feel able to hire them now. For the graduate with a moderate amount of money in reserve this adds to the opportunity. It may only take a little to induce the employer to put his plans into effect at once. The young man able to supply both the present needs of industry, and increase in capital and new blood, is in a position to secure much more favorable consideration than he has any reason to expect in the future.

The ordinary person has his difficulties today. But the young man with the ability, both

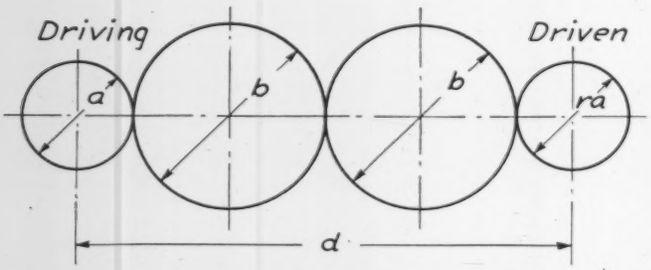
intellectual and financial, to take a three years course for a PhD, is the one who should grasp some of these opportunities for an exceptionally favorable start in industry. In doing so, he will not only be making the most for himself but he will be making a step toward business recovery.

—A. W. FORBES,
Worcester, Mass.

Optimum Size of Intermediate Gears

To the Editor:

IN DETERMINING the optimum size of intermediate gears in a spur gear train, such as the one shown in the accompanying illustration, a group of formulas can be worked out that will



Diagrammatic arrangement of gears used for determining optimum size of intermediate gears

simplify calculations considerably. Assuming that a train of spur gears is to be designed for connecting a driving and driven shaft, the gear centers being all in one straight line and the intermediate gears being all of the same size, let n be the number of intermediate gears to be used, and r the ratio of pitch diameters of the driven to driving gear.

The total pitch area of the entire train will be

$$\frac{\pi a^2}{4} + \frac{\pi r^2 a^2}{4} + \frac{n \pi b^2}{4}$$

which can be written

$$\frac{\pi}{4}\left[a^2 (r^2 + 1) + n b^2 \right]$$

but

$$\frac{a}{2} + n b + \frac{r a}{2} = d$$

whence

$$a = \frac{2 d - 2 n b}{r + 1}$$

Substituting this value, the total pitch area becomes

$$\frac{\pi}{4}\left[\frac{(2 d - 2 nb)^2 \times (r^2 + 1)}{(r + 1)^2} + nb^2 \right]$$

which can be written

$$\frac{\pi}{4 (r + 1)^2} \left[b^2 (4n^2r^2 + 4n^2 + nr^2 + 2 nr + n) - b (8ndr^2 + 8nd) + (4d^2 + 4d^2r^2) \right]$$

To obtain the conditions when this total area will be at its minimum value, we equate the differential coefficient of the above expression to zero:

$$b (8n^2r^2 + 8n^2 + 2 nr^2 + 4nr + 2n) - 8 ndr^2 - 8nd = 0$$

whence

$$b = \frac{4 dr^2 - 4d}{4 nr^2 + 4 n + r^2 + 1 + 2r}$$

which can be written

$$b = \frac{4 d (r^2 + 1)}{(4 n + 1) \times (r^2 + 1) + 2r}$$

This last expression gives the proper value for the pitch diameter of the intermediate gears in terms of the given values n, d and r for greatest economy of material, weight and inertia. From this formula for b we easily can calculate the pitch diameters of the end gears, remembering that

$$a = \frac{2d - 2nb}{r + 1}$$

In the simplest case where $n = 1$ we find the following values for b:

If r equals	b equals	Gear diameters in the train*		
1	$2d/3$	1	2	1
2	$20d/29$	1	3 1/3	2
3	$5d/7$	1	5	3
4	$68d/93$	1	6 4/5	4
5	$26d/35$	1	8 2/3	5
6	$148d/197$	1	10 4/7	6

*Values in the middle column (pitch diameter of intermediate gear) are $2 (r^2 + 1) / (r + 1)$ in all cases.

Slight alterations in the prescribed sizes of course must be made to obtain gears with an integral number of teeth.

—FREDERIC B. FULLER,
Springfield, Mass.

Designing Style Into Machines

To the Editor:

THE editorial, "Do Not Overlook Significance of Style in Design," in the June issue certainly touched a tender spot in the minds of many machine designers. It cannot be said that the wide-awake designer has not, in past years, made great strides in the appearance of his machines. Just as the automobile manufacturer has evolved from the "horseless carriage" through the years up to the present day streamlined body, so many of the latest machines of various types have shown as decided a tendency toward attractiveness to the eye.

"Good looking" is not a difficult term to explain, although it has not been stressed to any great extent in sales talk. The modern designer takes advantage of large radii in his castings. He has forsaken the sterner lines and has turned them into soft flowing contours. General ma-

chine lines are kept unbroken by attachments that look like afterthoughts. He uses the smaller and neater steel casting or forging, in preference to the larger gray iron casting for levers, brackets, etc.

The up-to-the-minute designer certainly has been artistic in recent years, but the foregoing does not mean that there is no room for improvement. We shall await with interest further comments on the subject.

—F. A. FIRNHABER,
Waynesboro, Pa.

Is Engineering Training Too Narrow?

To the Editor:

IT SEEMS to me that the men answering the questionnaire of the Ohio State faculty, quoted on page 50 of the May issue, overlooked two extremely essential requisites of the modern engineer's training. I refer to Advertising and Sales; not that I think an engineer should be expert in both; but he should be familiar with the theory and practice. Certainly these are as essential as Economics. As stressed previously in MACHINE DESIGN, the engineer-designer of today must know what the public and trade wants and why they want it. With this knowledge he will be well prepared to fill the demand.

Practically all of our present day successful machines and products are a distinct departure from the old models and the trend is more than ever toward new and novel designs. It is the tempo of the times and if the engineer has a good background in advertising and sales essentials together with his mechanical training, he will be well fortified to cope with the unusual conditions in manufacturing today and in the future.

—J. M. MURPHY,
Lakewood, O.

Revise Design Standards!

To the Editor:

WHILE the technical press has emphasized the advantages to be gained from design development at a period such as the present, it generally has urged the development of new models or experimental machines. I am in entire accord with this policy, but there is a concurrent design development, not nearly so costly in time or effort, which may well effect accrued economies and design gains far in excess of its slight cost. I refer to a thorough checking and review of formulas and of basic structural unit design values used in designer's computations.

We are all familiar with the consistent development in materials which has taken place in the postwar years; yet many designers have neglected to take full advantage of increased strength in the unit values they use in detail design. I have found in some cases that while tests already made and readily available point out the need for reduced unit values or increased factors of safety under certain specific conditions, findings have not been correlated with the data sheets giving the supposed unit values for all uses, so that in the detail development of design the real value of these tests and the money invested is only working part time, if at all. An intimate review, such as suggested, will not only bring about the raising of these general unit values in accordance with current material development but it properly will bring to application the particular restrictions of design peculiar to each industry or class of product. The result not only will be a better designed product on the next job, but on all design jobs to come, coupled with the hope that in the future, through this emphasis, changes in unit design values will be made effective immediately whenever they occur.

—JOHN F. HARDECKER,
Philadelphia

Revises Casting Specifications

SPECIFICATIONS for gray iron castings have been revised by American Society for Testing Materials to a tentative form known at A48-32T, developed after several years research work by the Gray Iron institute. New features of the specifications of interest to gray iron producers and users are: Classification of gray iron into seven tensile groups—20,000, 25,000, 30,000 35,-000, 40,000 50,000 and 60,000 pounds per square inch; and increase of tensile and transverse bar sizes for standard testing from one to three in order to provide adequate design information pertaining to various sections in castings.

It now will be possible for foundrymen to state specifically the strength which can be expected in critical sections of their castings. Heretofore the single arbitration test bar has not given results which could be applied satisfactorily throughout the whole range of section sizes. A certification plan is being worked out whereby any foundry submitting its iron to suitable tests and metallurgical inspection can certify that its product fulfills the requirements for one of the classes.

The Gray Iron institute, Cleveland, has made some 12,000 tests on bars varying from $\frac{3}{8}$ to 2.2-inch diameter and has a mass of data available, so that it can assist any engineer or foundryman in applying information concerning physical properties of gray iron to structural castings of all types.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

COMMEMORATING the seventy-fifth birthday anniversary of Frank J. Sprague, noted engineer, scientist and inventor, members of the various technical societies gathered recently at the Engineering Societies auditorium, New York, in a meeting of appreciation and tribute. Mr. Sprague is called the "father of electric traction." In 1883 he made an outstanding record in mathematical determination of electrical distribution.

Development of remote control and equipment for elevator operation now used universally; the first operative model of a dual elevator; demonstration of the practicability of motors for railway use; constant speed motors which developed into wide industrial application, all are the result of his engineering acumen.

Milford, Conn., July 25, 1857, were the place and date of his birth. From 1874 to 1878 he was enrolled at the United States naval academy, resigning from naval service in 1883. Subsequent activities in which Mr. Sprague was engaged comprise in part, one year as assistant to Thomas A. Edison, organization of the Sprague Electric Railway & Motor Co. in 1884, and formation of an electric elevator company and electric company in 1892 and 1897, respectively. Numerous medals have been awarded to him and in 1932 he was made an honorary member of the American Institute of Electrical Engineers, of which he also is a past president.

VERSATILITY best characterizes Cloyd M. Chapman. After he was graduated from Sibley college, Cornell university, in 1898 as a mechanical engineer he enlisted in the navy. That was at the outbreak of the Spanish-American war. When hostilities ceased he entered the employ of Thomas A. Edison, serving as an assistant in his private laboratory on experimental work. Just recently Mr. Chapman became president of the American Society for Testing Materials, a post to which he brings a deep understanding of important engineering phases.

Akron, O., was his birthplace, 1874 the date. His work has taken him to various parts of the country and also to foreign soil. The period from 1905 when he entered the firm of Westinghouse, Church, Kerr & Co., until 1920 was a busy one for him. While with this company he was responsible for design and construction work and was engineer of tests, specializing in power and manufacturing plant design as well as in the design of special machinery.

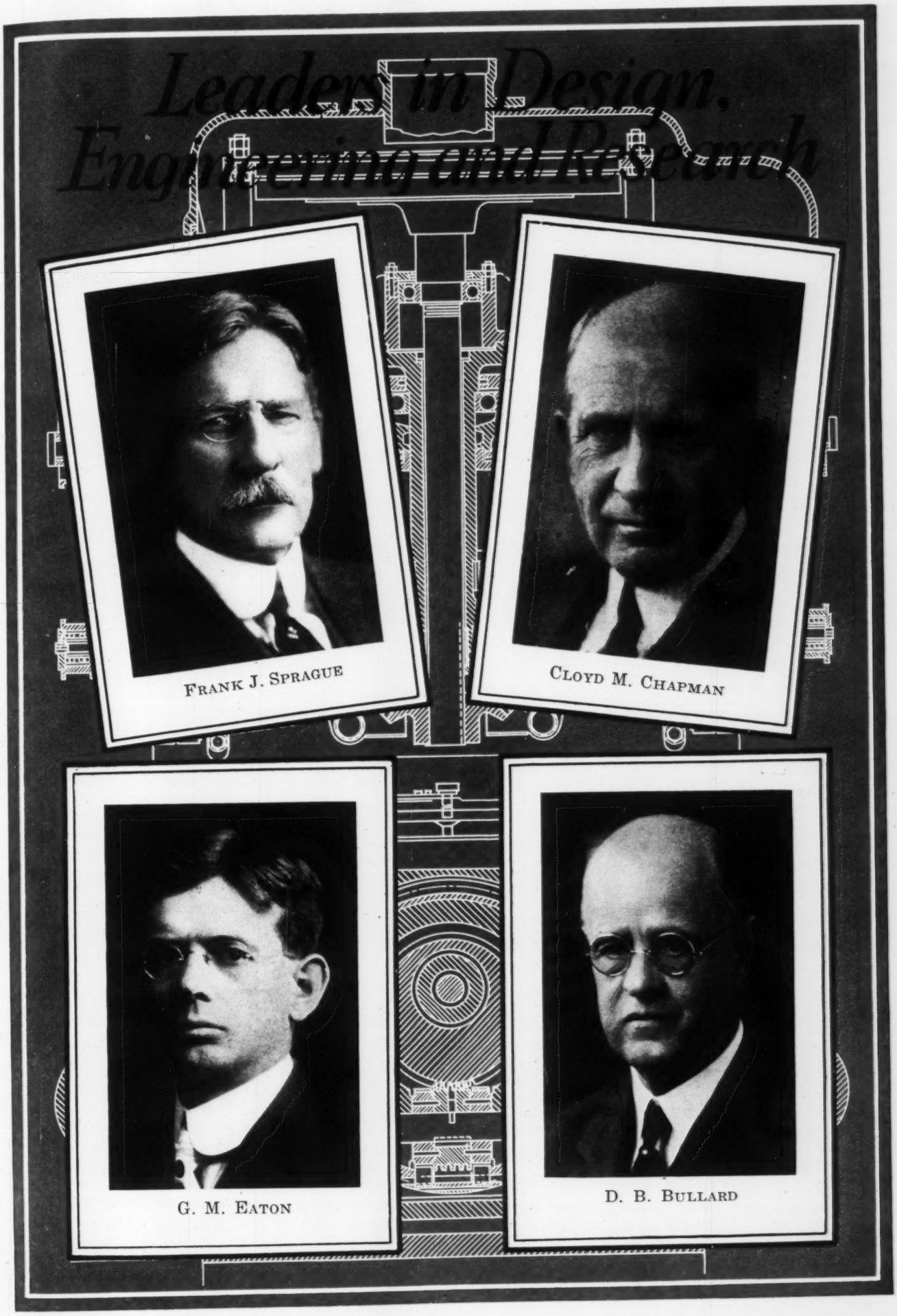
Since 1920 Mr. Chapman has practiced as a consulting engineer. Endowed with an intuitive mind, his inventive traits were developed by his close contacts with Edison. Through his connection with the American Society for Testing Materials and the American Standards association, he has done much to forward the work on materials standardization.

LARGELY responsible for the organization of the applied mechanics division of the American Society of Mechanical Engineers, G. M. Eaton has earned an enviable reputation as an engineering pioneer. Recently he sprung into additional prominence as one of the new members of the A. S. M. E. standing committee on research.

Commencing his engineering career as a draftsman with the Newport News Shipbuilding & Drydock Co., he rose to the position of chief draftsman before resigning to become associated with Westinghouse Electric & Mfg. Co. In the 20 years he was with the latter he advanced from engineer in the railway engineering department to chief mechanical engineer. Joining the Molybdenum Co. in 1926, Mr. Eaton devoted the succeeding five years to research, commercial development and direct sales activity. At the present time he is a director of research, Spang, Chalfant & Co.

Worcester Polytechnic Institute is the school from which he was graduated. He is the holder of many patents and has been active in several engineering societies. Recently he retired as chairman of the A. S. M. E. standing committee on meetings and programs.

RECENT appointment of D. B. Bullard to the standing committee on research of the American Society of Mechanical Engineers attests to his place in engineering. As vice president of the Bullard Co., Bridgeport, Conn., he


Leaders in Design.
Engineering Research
FRANK J. SPRAGUE
CLOYD M. CHAPMAN
G. M. EATON
D. B. BULLARD

commands a broad understanding of the profession and will be able to contribute vitally to the body which supervises the activities of the society's 25 co-operative research committees.

Early engineering training was gained by Mr. Bullard from practical experience as an apprentice and draftsman in the machine tool manufacturing plant of his father, E. P. Bullard. In the ensuing years he became superintendent and subsequently chief engineer. The latter position he still holds, simultaneously executing his duties as vice president and director.

Since 1889 he has been a member of the American Society of Mechanical Engineers, assuming an important part in the organization of the Bridgeport section. This year he is its chairman. In 1930 Mr. Bullard was elected president of the Bridgeport Engineer's club. His fraternal and social affiliations are numerous, indicative of a well-rounded life of activities from engineer to businessman and sportsman.

* * *

R. E. Lankford has been appointed works manager of the J. A. Fay & Egan Co., Cincinnati. He will have complete supervision of the design, engineering and manufacturing of the new line of precision, high-speed woodworking machinery soon to be placed on the market.

* * *

Lynn H. Ransom has been appointed chief engineer for the Keystone Driller Co., Beaver Falls, Pa. He had been connected with the engineering department of the Keystone company since 1926.

* * *

Ramon Lozano Portillo, chief, Laboratoria de la Secretaria de Obras Publicas, Havana, Cuba, has replaced Armando Basarrate Morales as representative of the American Society for Testing Materials on the sectional committee on petroleum products and lubricants.

* * *

R. A. Seaton, dean of engineering, Kansas State College, was elected president of the Society for the Promotion of Engineering Education at the recent annual meeting at Oregon State college, Corvallis, Oreg.

* * *

Major Oscar Van Pelt Stout of Oakland, Calif. was awarded the first Cyrus Hall McCormick medal of the American Society of Agricultural Engineers at the recent annual meeting in Columbus, O. It was given for exceptional and meritorious engineering achievement in agriculture.

* * *

R. C. Darnell recently was made chief engineer of Handy Governor Corp., Detroit.

* * *

Juan de la Cierva has been awarded the Daniel Guggenheim gold medal for 1932 in recognition of his development of theory and practice involved in the autogiro.

* * *

F. L. Tarleton, formerly with Westinghouse Electric & Mfg. Co., Springfield, Mass, has been appointed research engineer with Gibson Electric Refrigerator Corp., Greenville, Mich. He had been with the former company in experimental refrigeration for six years.

* * *

Ralph E. Flanders has been accorded the honorary degree of mechanical engineer by Stevens Institute of Technology. He is manager of Jones & Lamson Machine Co., Springfield, Vt.

* * *

Prof. Charles E. Seitz of Virginia Polytechnic Institute, is the new president of the American Society of Agricultural Engineers, having been elected at the recent annual meeting at Columbus, O.

* * *

Robert F. Mehl, assistant director of research for the American Rolling Mill Co., Middletown, O., has been appointed director of the bureau of metallurgical research at Carnegie Institute of Technology, Pittsburgh.

* * *

A. A. Potter, dean of the schools of engineering, Purdue university, was nominated as the new president of the American Society of Mechanical Engineers at the recent summer meeting. Other officers nominated were: Vice presidents, Harold V. Coes, Ford, Bacon & Davis, New York; Clarence F. Hirshfield, research department, Detroit Edison Co.; James D. Cunningham, president, Republic Flow Meters Co., Chicago; Managers, R. L. Sackett, dean of engineering, Pennsylvania State college; Alex D. Bailey, Commonwealth Edison Co., Chicago; John A. Hunter, professor of mechanical engineering, University of Colorado.

Nominations of representatives of the society on the American Engineering council included:

Blake R. VanLeer, dean of engineering, University of Florida; Prof. Joseph W. Coe, New York university; D. Robert Yarnall, Yarnall-Waring Co., Philadelphia; Dean B. M. Brigman, University of Louisville; Ernest Kreher, president of Tampa Shipbuilding & Engineering Co., Tampa, Fla.; Prof. Hugo Diemer, LaSalle Extension university; and William A. Hanley, Eli Lilly & Co., Indianapolis.

* * *

Eugene L. Beecher now is chief engineer of the Gabriel Co., Cleveland. He formerly held the position of research engineer.

* * *

George B. Ingersoll has resigned as chief engineer, Federal Motor Truck Co., Detroit, and will devote his time to patent law practice in that city.

* * *

Dr. Webster N. Jones, general superintendent, processing division, B. F. Goodrich Co., Akron, O., Aug. 1 became director of engineering of Carnegie Institute of Technology, Pittsburgh.

* * *

P. L. Alger, General Electric Co. and F. D. Newbury, Westinghouse Electric & Mfg. Co., presented "The Development of Electrical Machinery in the United States," before the International Electrical conference held in Paris recently.

* * *

Dr. Howard Monroe Raymond recently resigned as president of Armour Institute of Technology concluding an association of 37 years with the school. In 1903 he was made dean of engineering and on the death of Dr. Frank Gunsaulus was elected president.

* * *

Earl C. Smith recently was promoted to the position of chief metallurgist of Republic Steel Corp. In his new capacity he will make his headquarters at Youngstown, O., and besides other work will continue his duties in developing new steels for special purposes.

* * *

John G. Goetz has been appointed managing director of the American Management association to succeed Dr. W. J. Donald, who resigned recently to become a member of the management engineering and accounting firm of James O. McKinsey & Co., of New York and Chicago. Dr. Donald will continue as vice president in charge of conferences and programs.

* * *

At the recent meeting of the mechanical division of the American Railway association the following officers were elected: Chairman, E. B. Hall, general superintendent of motive power, Chicago and North Western railroad; vice chairman, O. A. Garber, chief mechanical officer, Missouri Pacific railroad; members of the general committee, C. E. Chambers, F. R. Mays, John Purcell, R. L. Kleine, J. W. Highleyman and R. G. Henley.

* * *

J. G. Lanning is the new chief engineer of Hawley-Jones Corp., Corning, N. Y. He formerly was connected with the Detroit Lubricating Co. and Manning, Maxwell & Moore.

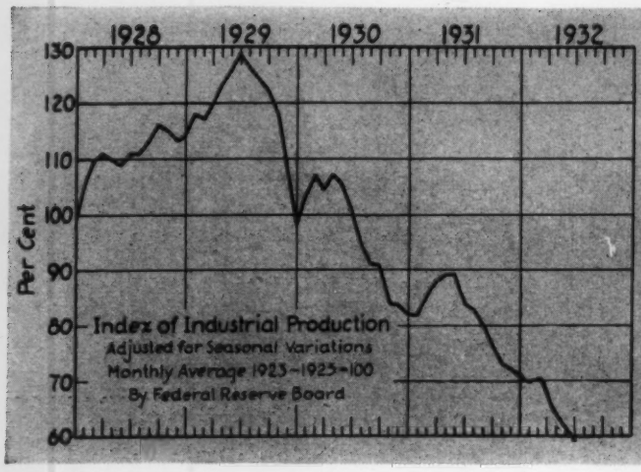
Obituaries

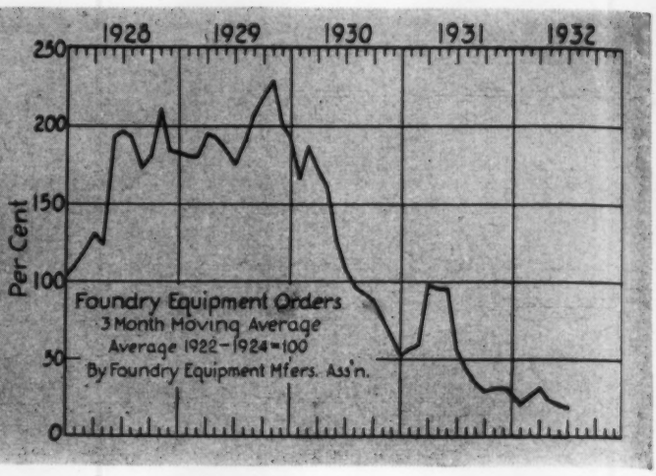
DR. GEORGE K. BURGESS, 58, director of the bureau of standards, and outstanding as a scientist, died suddenly July 2 at Washington. He was stricken suddenly at his office and succumbed enroute to a hospital.

A native of Newton, Mass., Dr. Burgess obtained his collegiate and technical education at Massachusetts Institute of Technology and the Sorbonne in Paris. He joined the bureau in 1903 and was appointed its director in 1923 by the late president Warren G. Harding. As a member of numerous technical commissions and boards, he represented the United States at a number of international scientific conferences. Dr. Burgess taught physics at Massachusetts Institute of Technology, University of Michigan and University of California, prior to entering government service. He was a past president of the American Society for Testing Materials and American Society for Steel Treating.

* * *

Luther D. Burlingame, industrial superintendent of the Brown & Sharpe Mfg. Co., Providence, R. I., died recently at the age of 67. Following his graduation from the Providence High School in 1884, he entered the employ of the Brown & Sharpe company, at Providence. In 1914 Mr. Burlingame became industrial superintendent, chairman of the safety committee and specialist in patent work. For many years he had represented the company in numerous technical societies, especially in the work of the American Society of Mechanical Engineers, where he held responsible assignments.



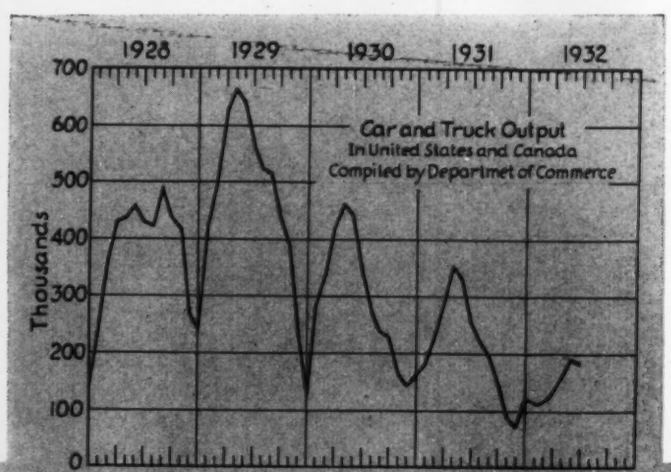


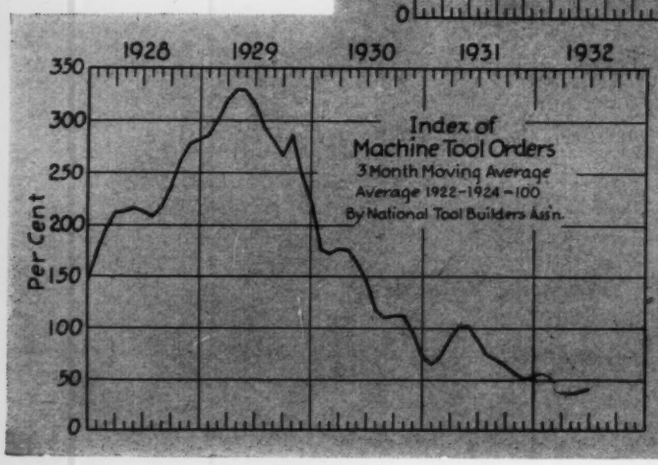
How Is Business?

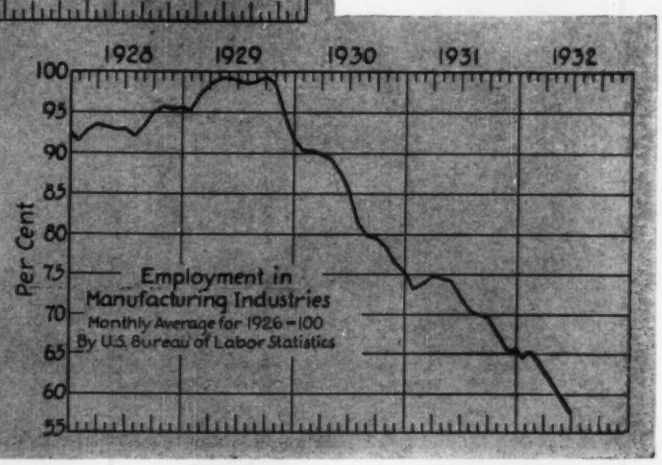
MASS hysteria, that potent influence that aided materially the acceleration of the slump three years ago, has again begun to operate in favor of improving business. Once before in this depression, in the fall of 1931, it appeared that a grand rush to get on the band wagon would quickly bring definite improvement, but at that time the banking situation legislated against the advance.

Today, however, with the financial picture much improved, business sentiment throughout the country is the best that it has been since 1929. Business is still poor, but the general optimism expressed by executives is extremely encouraging. Reports of improvement in one company bring about improvements in another, and so on down the line goes the desire to be one of the first to pull out of the hole. The positive action which follows this desire has been sorely needed.

Stabilization factors that have aided the business attitude are the results of the Lausanne conference, and the more than seasonal improvement in livestock and grain prices. Another indication of the change in style of thinking is reflected in the hog market. Here prices have risen to a level that would be expected to produce a rush of sellers who wished to profit by the unusual opportunity, yet the increase in hogs offered has, if anything, been less than seasonal. Perhaps it is the first trend from the disastrous buyers market to a sellers market, a trend that would be extremely beneficial to industry as a whole.







TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

WHEN congress adjourned recently the patent bills about which more or less controversy had centered in the preliminary hearings were still being considered. This makes it unlikely that any action regarding the bills will be taken by the present administration, the next session being a short term. The only legislation passed which affects the present status of patent law is the increase in filing fees from $25 to $30, effective Aug. 1, with a similar increase in final fees. Other governmental charges connected with the issuing of a patent through the United States patent office have been increased proportionately.

It was on May 3 last that the bills outlined briefly in the following were favorably reported to the house of representatives. One is designed to amend the statute relating to patent disclaimers, changing the text to read in part: "Whenever through inadvertence, accident or mistake, and without any fraudulent or deceptive intention, a patentee has claimed more than that of which he was the original or first inventor or discoverer, his patent shall be valid for all that part which is truly and justly his own, provided the same is a material or substantial part of the thing patented."

Other proposed bills would limit inventors to priority of two years before filing applications for patents, aside from the law governing public use; abolish statutes permitting renewal of patent applications; expedite prosecution of patent applications pending more than three years; limit life of patent to term commencing with date of application; permit single signature in patent application and validating joint patent for sole invention; empower assignees of inventor to file divisional, continuation, renewal or reissue application; and prevent fraud, deception, or improper practice in connection with business before the patent office.

* * *

Framework of Dirigible Macon Is Completed

FOLLOWING the recent completion of the framework of the U. S. S. MACON, sister ship of the Navy dirigible AKRON, work on the covering of the giant airship now is under way. More than 10,000 people gathered at the dock on the Fourth of July to see the bow and last section of the framework hoisted into place.

Engineers in charge of construction estimate that the MACON will be ready to fly next January. Trial flights will be conducted during the winter months under entirely different atmospheric conditions than those which prevailed last summer when the AKRON was tested and approved by the navy.

* * *

Scope of Noise Measurement Enlarged

CHANGE in the title and scope of the project on noise measurement which was recommended to the American Standards association by the sectional committee at its organization meeting has been approved by the standards council. The former scope restricted the work of the committee to units, scales, terminology, and methods of measurement in the field of noise measurement, while the new scope permits fundamental standardization in the general field of acoustics.

The new title of the project is acoustical measurements and terminology and the scope is: Preparation of standards of terminology, units, scales, and methods of measurement in the field of acoustics. Two new subcommittees will be appointed as a result of the enlarged scope of the project, one to cover sound insulation and absorption, the other to cover fundamental sound measurements.

* * *

Automotive Designers Undergo Criticism

DESIGNERS in the automotive industry heard their work severely criticised by William B. Stout, noted airplane builder, at the recent summer meeting of the Society of Automotive engineers. He charged them with designing "a lot of dumb things into automobiles." Structural analysis should be applied to better advantage—to reduce weight, for instance, by intelligent use of suitable structures. Simplification of controls was another point he laid stress upon.

Automobiles cannot be streamlined like airplanes, Mr. Stout declared, because the air does not always come from the front. Side wind effects also must be considered. Passengers should ride between the axles and not over them, "eye high." Low cars give the sensation

of being stepped on and high-riders produce a "falling out" sensation. Waste space which comes from lack of forethought, robs the owner of 50 per cent of the possible luxury he should get from his wheelbase.

* * *

Symbols Presented in Tentative Form

DISTRIBUTION of the proposed recommended practice covering drawings and drafting room practice on graphical symbols recently was made by the American Society of Mechanical Engineers. The draft is subject to revision, being submitted in tentative form for criticism and comment. Copies may be obtained from, and suggested changes addressed to Thomas E. French, chairman of the subcommittee, American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York.

The proposal covers sets of recommended symbols for plumbing fixtures, conventional rivet layouts, heat-power apparatus, electric power apparatus, pipe and pipe fittings, and heating and ventilating layouts.

* * *

S. A. E. Standards Committee Reorganized

CHANGING conditions in national and international standardization activities has brought about important changes in the regulation of the standards committee of the Society of Automotive Engineers. Whereas in the past all members of divisions constituted the standard committee, in the future only the chairman of divisions will be members.

However, the scope of all formal activities of the society is represented on the committee, and if any future activity is not so represented the standards committee will arrange for such representation. At future annual and semiannual meetings of the society the general standards session held formerly will not be held, as the standards committee will meet instead.

* * *

Course in Lubrication Prepared by A. S. M. E.

OVER the past few months the American Society for Mechanical Engineers has received many requests from industry for information on lubricants and bearing testing machines and special information regarding the lubrication of advanced types of all classes of machinery. To meet this demand, the lubrication engineering committe of the petroleum division of the society, after consultation with the leaders of various branches of industry, considered that it was advisable to prepare a complete course of instruction for the training of lubrication engineers.

The report that is being compiled will deal with the fundamentals of lubrication and with the application of the lubricants to all classes of machinery. It also will explain the testing of such machinery to determine if the most effective lubricants have been applied and indicate how a correction of the application systems can be utilized to bring about the highest degree of economy with the lowest cost for power and maintenance. The report is in its last stages of preliminary writing and after its acceptance by the various trade associations will be made available through the society.

* * *

Designs Electric Watch of Ordinary Size

AFTER 12 years of experimenting George Pellaton, a former watchmaker of Geneva, Switzerland, has developed an ordinary-sized electric watch. The outstanding feature of his achievement was in overcoming the difficulty of making a small accumulator to fit inside the case. The charge lasts for a year, an ordinary wireless set being capable of recharging the accumulator. Patents already have been granted for the timepiece in Switzerland and Mr. Pellaton is taking them out in the United States and in other countries also. He now is attempting to apply his invention to wrist watches.

* * *

Depression Good for Young Engineer

SPEAKING before members of the American Institute of Electrical Engineers recently, Dr. Charles E. Skinner found value in the depression for the young engineer who is experiencing difficulty in obtaining and retaining employment. This temporary adversity will bring out the best in these men, he said, adding that graduates of such times go further than those of other times when positions are easy to secure and to hold.

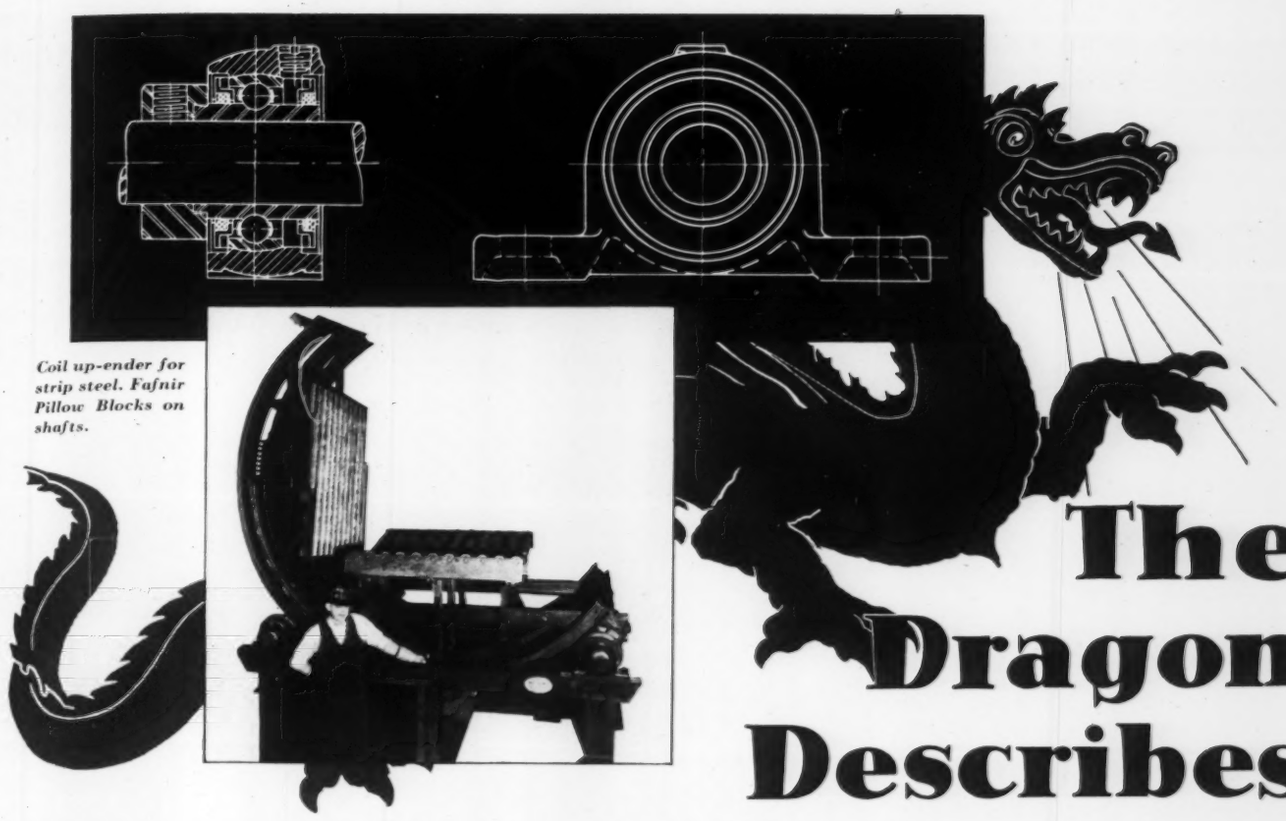
* * *

New Products Conference Is Planned

RECENT announcement of a new products conference to be held in Cleveland during the last week in September has aroused considerable interest among designers, engineers and manufacturers. The conference is sponsored by Cleveland Engineering society.

One of the objects is to provide practical help for manufacturers who are contemplating or actually engaged in the development and marketing of new products. It is intended to hold sessions dealing with the various phases in the development of a new product from the time the idea is conceived in the mind of the engineer or inventor until the commercial product is placed in the hands of the consumer.

Steps are being taken also to investigate the possibility of holding an exhibit of new products and inventions in conjunction with the conference.



Coil up-ender for strip steel. Fafnir Pillow Blocks on shafts.

The Dragon Describes *a new pillow block installation*

"As broad as industry itself" adequately describes the variety of applications of conveyer systems such as made by the Mathews Conveyer Co. The ability to meet Mathews' ball bearing specifications calls not only for accurate precision, compactness and capacity but also for an unusually wide range of types and sizes. The exclusive selection of Fafnir Ball Bearings is evidence of the value of Fafnir service—the ability to supply the suitable bearings—the flexibility to meet the widely varying demands from "the most complete line of types and sizes in America."

When Mathews recently adopted ball bearing pillow blocks for all moving shafts, the Fafnir type recommended proved ideal. This design makes use of the Wide Inner Ring Bearing with self-locking collar and interlocking eccentric cam and is self-aligning within the housing to provide for possible shaft misalignment. To meet the almost unlimited variety of conveyer system applications, 24 sizes of this particular type of Fafnir Pillow Block are available—from $\frac{9}{16}$" to $2\frac{3}{16}$" shaft size. And other series offer a still wider range.

An engineering staff capable of solving this type of ball bearing problem and many others is at your service. Why not take advantage of this experience for your own applications? It's yours for the asking.

**A recent issue of the Dragon carries the complete story of this interesting problem. It's an issue that every one should read—if you haven't already, we will be glad to forward it upon request.*

THE FAFNIR BEARING COMPANY, New Britain, Conn.
Atlanta Chicago Cincinnati Cleveland Dallas Detroit
Los Angeles Milwaukee Newark New York Philadelphia

Fafnir·Ball·Bearings

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

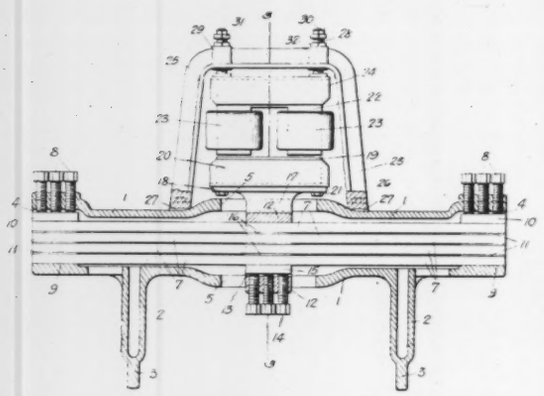


Fig. 1—Electric reciprocating motor designed to be energized to produce vibratory movements at a high frequency

TO EFFECT vibration or reciprocation of material treating apparatus such as screens, concentrators or crushers, or of percussive tools such as rock drills, riveting hammers, etc., an electric reciprocating motor or vibrating mechanism has been designed by James A. Flint. The recently granted patent covering the invention has been assigned to Traylor Vibrator Co., Denver, Colo., it being No. 1,846,326. Simplicity and compactness are singular features of this device.

Fig. 1 and 2 show the invention as an element of a machine for screening ores and other materials. The longitudinal section of the screen structure, Fig. 1, depicts the manner of mounting the electric reciprocating motor. In this case two vibrating mechanisms are employed, one of which is supported by each of the side frames 1, Fig. 2.

Clamped or fixed to the middle portion of each vibrator element constituted by the two groups of bars 7, is a bracket 12. Each bracket is provided with a web 17 carrying a flange 18 for supporting the armateure 19 of the electro-magnetic unit. This armature is mounted in a core holder 20 of nonmagnetic material.

The stator portion of the electro-magnetic unit comprises a laminated C-shaped core 22, upon the arms or poles of which are arranged energizing coils 23 adaptable for alternating or pulsating current.

Operation of each vibrator unit begins with the electro-magnetic means applying a deflecting force to the vibrator 7, thereby moving it in one direction from neutral position and correspondingly moving the vibrated member. This deflection of the vibrator will cause the building up therein of a restoring force approximately proportional to the deflection, which ultimately tends to bring the vibrated member to rest and as the deflecting force diminishes or ceases between the alternations or pulsations of current tends to restore the vibrated member and vibrator to the neutral position.

Inertia carries the parts beyond the neutral position, thereby causing deflection of the bar in the opposite direction and developing therein a similar restoring force tending to arrest the movement of the vibrated member and then to restore it again to the neutral position. This restoring force built up in the vibrator will be assisted by the succeeding attracting or deflecting force of the electro-magnetic unit, and as the parts again reach neutral position this deflecting force of the electro-magnetic means together with the inertia of the vibrated member will again cause deflection of the vibrator element in the first direction, again building up the necessary restoring force therein.

It will be understood that the attractive forces are applied intermittently to the armature in such a manner as to cause it and the vibrator to vibrate at a predetermined frequency.

OF MORE than casual interest in transmission work is a safety clutch designed to actuate a brake or friction band to effect release of a drive pulley when torque on the shaft

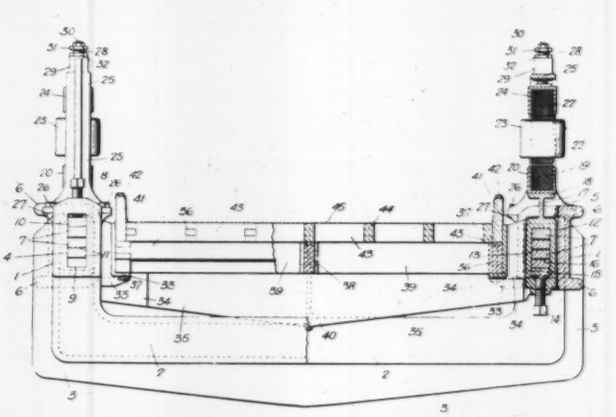
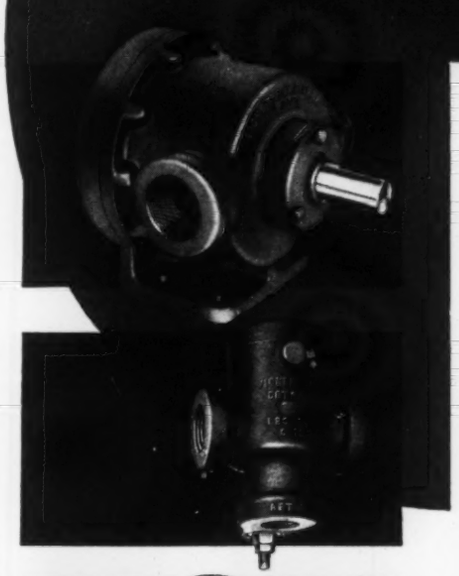


Fig. 2—Application of two operating motors or vibrating mechanisms on a screening machine is shown above

Vickers are now prepared to furnish COMPLETE HYDRAULIC CONTROLS for all kinds of machine tools

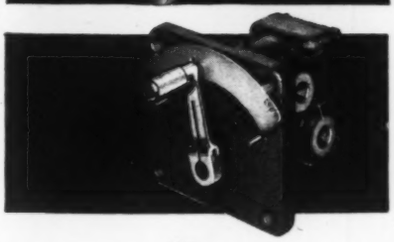
HYDRAULICALLY operated machine tools are now being provided with practically any required feeds and sequence of motions by using various arrangements of *standard* Vickers pumps, valves etc. Only a few of these standard Vickers units are shown here; others are: (1) two-stage rotary pump for 2000 lb. pressure, (2) piston type pump for 5000 lb. pressure, (3) combination pump (large volume and small volume driven from same shaft), (4) 3-way valves, (5) by-pass valves, (6) automatic feed for step-drilling deep holes, etc. etc.

Write for data regarding the application of Vickers pumps and valves to your machine tools. Correspondence regarding special hydraulic control problems is also invited.

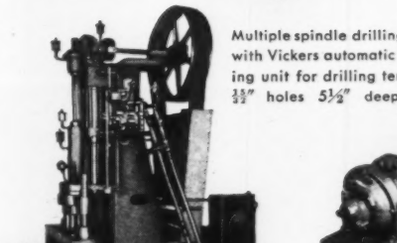


Vickers Vane-Type Rotary Pumps Used for working pressures to 1000 lb. per sq. in. and made in six sizes having capacities from 1¾ to 36 gal. per min. with list prices from $55.00 to $75.00. Speeds vary from 800 to 1200 r.p.m.; either foot or flange mounting is provided. Volumetric efficiencies and overall mechanical efficiencies are unusually high. Rotor is in hydraulic balance eliminating side thrust and consequent wear on bearings.

Vickers Hydraulic Relief Valves (Balanced) Made in two sizes (¾" and 1¼" pipe connections) for pressures to 2000 lb. per sq. in. Capacities are 0 to 15 and 10 to 40 gal. per min.; list prices are $25.00 and $35.00. The use of a balanced piston instead of the customary loaded spring makes this valve more sensitive, quiet and accurate throughout the pressure range. It is installed directly in the line (no tee needed) and in any position.



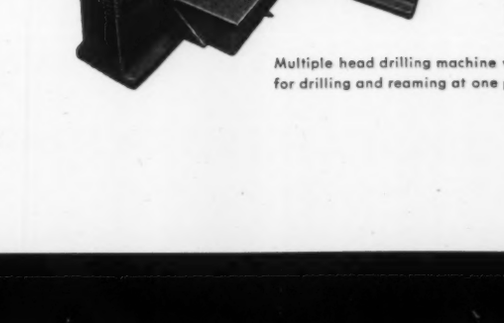
Vickers 4-Way Valves All are in hydraulic balance; this prevents pressure binding and assures more sensitive control. The manually operated valve shown is made in two sizes; ¾" valve has list price of $60.00 while 1¼" valve is priced at $85.00. The Vickers Pilot Operated 4-Way Valve provides remote control without levers, links, etc., and it can be placed out of sight or wherever most convenient. This valve is ¾" and has list price of $65.00. Manually operated and mechanically operated pilot valves are available; both have $25.00 list price. Another 4-Way Valve has a built-in latch type load and fire mechanism; operator manually starts machine and after one complete cycle the valve stops it. Valve is ¾" and has $70.00 list price. All valves are used for operating pressures to 2000 lb. per sq. in. A complete line of 4-way valves in ½" size is also available.



Vickers Feed Control Valves Vickers C-200 Feed Control Valve controls the feed rate of hydraulic cylinders. It is self-compensating for variations in work resistance and operating pressure so that a uniform feed is assured. This valve in the circuit makes it impossible for the tool to jump ahead when breaking through (as in drilling). The pipe connections are ¾" and the list price is $55.00.

Vickers C-700 Feed Control Valve (not shown) makes possible any combination and number of rapid traverses and working feeds in one cycle of the machine. When used with a straight line cam of the proper length, it will produce a rapid traverse, then a feed rate of any desired amount followed by another rapid traverse and then a different feed rate, etc. The size is 1¼" and the list price is $75.00.

Multiple spindle drilling machine equipped with Vickers automatic hydraulic step-drilling unit for drilling ten 13/32" holes 5½" deep.



Multiple head drilling machine with Vickers automatic hydraulic controls for drilling and reaming at one pass all holes in automobile bell housing.

VICKERS INCORPORATED
7752 Dubois Street, Detroit, Michigan

VICKERS
INCORPORATED

exceeds a predetermined point and subsequently re-establish driving connection when the torque drops. The device covered by patent No. 1,862,888 was conceived by Asger Eilersgaard, with Link-Belt Co., Chicago, as the assignee.

In Fig. 3 is shown a side elevation and a sectional view at *X* and *Y* respectively. The

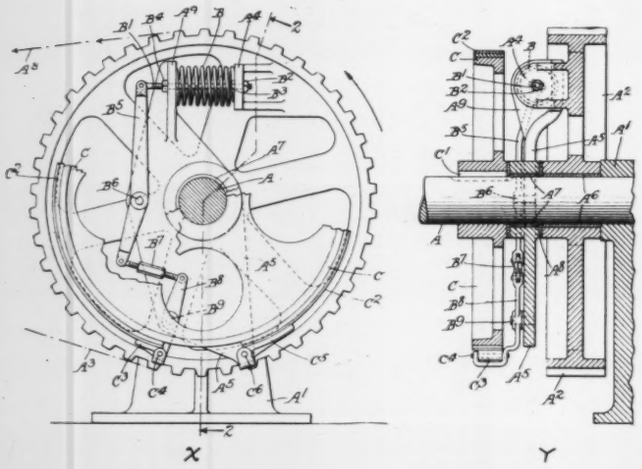


Fig. 3—Overload release which disengages automatically when torque exceeds a predetermined point

driven shaft *A* has a driving wheel or pulley A^2 mounted loosely upon it. Projecting laterally from one side of this wheel is a lug or abutment. A^4, opposite which on the irregular shaped release plate A^5 is another lug A^9. Spring *B* is compressed between these two lugs, through which passes a fin with a nut at both ends for adjustment. These nuts regulate the amount of load which may be transmitted before release takes place.

Transmission lever B^5 is pivoted at B^6 on the release plate A^5. One end is pivoted on pin B^1 and the other end carries an adjustable connecting link B^7. This latter link is pivoted on a brake lever B^8, the lever in turn being pivoted at B^9 on the release plate. Clutch wheel *C* mounted rigidly on shaft *A* by key C^1 is encirculed by a brake or friction band C^2, this band being supported at one end by the live end lug C^3 which is pivoted to the live end pin C^4 on brake lever B^8. The band is supported at its other end by a dead end lug attached by a pin to the release plate.

Tracing the operation from the position in which the parts are shown in *X*, Fig. 3, pressure exerted by the coil spring tending to separate the spring lugs, holds nut B^4 firmly against the back side of lug A^9. Lever B^5 thus is held in fixed position. Shackle B^7 can be adjusted to rotate lever B^8 with respect to fixed lever B^5 to cause the live end lug to move toward the dead end lug and so constrict the friction band upon the clutch wheel to effect the drive. In this position the lever system, clutch wheel and the friction clutch band all are locked together in driving relation.

Drive between the release disk and the driving wheel is provided by the precompressed release spring. If the resistance encountered by the shaft is so great that the pressure between spring lugs exceeds the resisting power of the spring, these lugs will compress the spring furclutch lever B^8 in a clockwise direction to seprotating transmission lever B^5 in a counterclockwise direction. This causes shackle B^7 to rotate clutch lever B^6 in a clockwise direction to separate the dead and live end lugs, releasing the tension of the friction band of the clutch wheel with resultant slippage so that the shaft will be driven no longer. This will persist until resistance to rotation of the shaft drops to a point at which the spring again will separate the lugs to bring nut B^4 against lug A^9, when normal drive will be resumed.

AMONG recent patents granted is one which relates generally to bearings and more particularly to the type made up of a shell of strong metal such as steel, to the inner and outer surfaces of which are secured sections of bearing metal. Louis Sandler is the designer of the bearing which is designated patent No. 1,862,279. Johnson Bronze Co., New Castle, Pa., is assignee.

As show at *A* and *B* in Fig. 4, and also in Fig. 5, the construction embodies a steel shell 2 and an outer ring-shaped section 3 of bearing metal adapted to fit into a corresponding recess formed

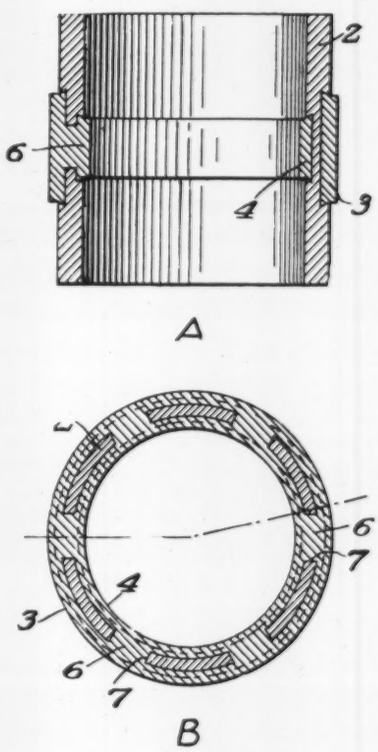
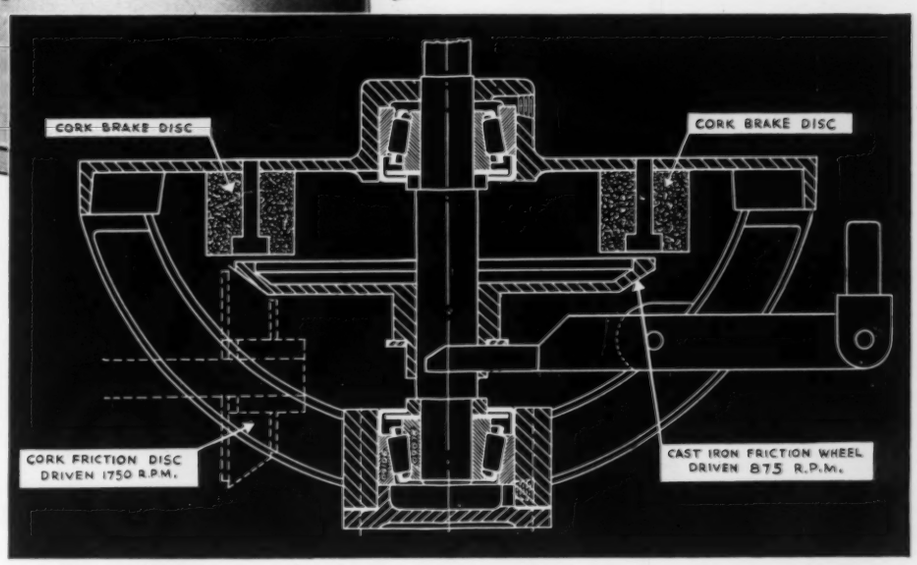


Fig. 4 — Sections showing construction of bearing which eliminates the use of means such as solder to secure the bearing metal to the shell. Outer section 3 of bearing metal and inner section 4 are linked together and locked to shell 2 at spaced intervals by projections 6

in a machine part such as a connecting rod. The bearing metal section is secured to the shell without resorting to any means such as soldering, being locked securely to the shell by pouring the

FRICTION DRIVE and FRICTION BRAKE are FACED with CORK



IT STARTS WITH CORK AND IT STOPS WITH CORK

In this Grinnel centrifugal extractor type washing machine, a cork friction disc drives a cast iron wheel. The machine is stopped by engaging the driven wheel with a cork brake disc.

WANTED . . . A friction surface to transmit driving power instantly and surely, and a friction material to make braking positive and dependable. Both needs of the Grinnel Washing Machine Company were met by Armstrong's Cork.

The Grinnel machine not only washes clothes, but dries them. The perforated inner shell is set in revolution, removing the water from the clothes by centrifugal force. After testing various materials by running them submerged in grease and water, Armstrong's Cork was selected as the most efficient material for transmitting power and for braking.

Armstrong has developed special cork composition for applications like this which involve frictional driving or braking in connection with relatively light loads. No matter how Armstrong's Cork is cut, its surface presents hundreds of tiny air cells which grip like vacuum cups. It cannot wear smooth—will not glaze with use. And the efficiency of Armstrong's Cork is not materially lessened when it is greasy or wet.

How About Your Problem! Our Industrial Sales Engineers can help you with *your* problems of driving, braking, cushioning, sound deadening, insulation, or sealing. Armstrong's Cork can be shaped and controlled to your specifications. Outline your problems and send a blueprint, if possible. Armstrong Cork & Insulation Company, Industrial Sales Division, 918 Arch Street, Lancaster, Pennsylvania.

Armstrong's (A) *Product*

Armstrong's CORK

MADE TO YOUR SPECIFICATIONS

bearing metal while in liquid condition. Elimination of soldering is advantageous due to the fact that the soldered joint would tend to act as an insulator and prevent dissipation of heat.

An inner ring-shaped section 4 of bearing metal is secured to the inner surface of shell 2, an inner lining 5, Fig. 5, of babbit metal covering the entire surface of the shell. Outer section 3 and inner section 4 of bearing metal are connected at spaced intervals by projections 6 of bearing metal extending through openings 7

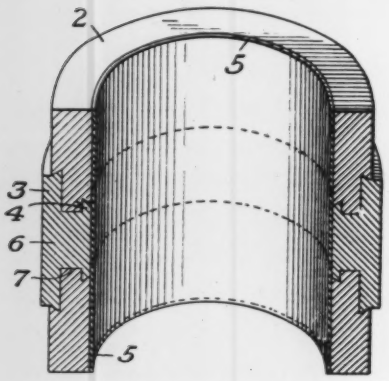


Fig. 5—Vertical section of finished bearing, completed by machining off the surface of the inner ring 4 so that it lies flush with the inner surface of shell 2, and subsequently lining the shell with a layer of babbitt metal 5

formed in shell 2 as depicted at *B*, Fig. 4. Projections 6 act as conductors for heat dissipation.

The finished bearing shown in Fig. 5 is made by machining off the surface of inner ring 4 so that it lies flush with the inner surface of shell 2 and subsequently lining the inner surface of the shell with a layer 5 of babbitt metal.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

ARMATURE WINDING MACHINE—1,865,461. Covered by this patent is a machine for winding wire into slots of an armature core, the machine being constructed so as to prevent the wire which passes around the ends of the core, from covering any portion of these slots which are between the slots into which the wire is wound. Assigned to Delco-Remy Corp., Dayton, O.

CENTRIFUGAL GOVERNOR—1,864,853. A centrifugal governor having fixed and sliding brushes with abutments arranged on them recently was granted this patent. Transversely disposed surfaces on the ends of flexible and elastic members engage with the abutments. Assigned to Garrard Engineering & Mfg. Co. Ltd., Swindon, England.

CAN WASHING AND FEEDING MECHANISM—1,850,067. The object of this invention is to provide a device for accommodating a number of cans, the unit being able to adjust itself to different sizes of cans. The arrangement consists of a screw of worm which removes cans from a housing having adjustable walls. Assigned to Ayars Machine Co., Salem, N. J.

FLEXIBLE COUPLING—1,868,544. Combination of two coupling members arranged side by side and designed with a peripheral set of teeth on one of them. U-shaped springs embrace the teeth, the other coupling member cooperating with the sides of the U-shaped members. Assigned to Smith & Serrell, Mahwah, N. J.

TWISTING MACHINE—1,865,897. Object of the new device is to produce twisted cord in a compact, uniformly cylindrical and smooth form, and of even twist throughout regardless of the varying sizes of the strands. Assigned to U. S. Ring Traveler Co., Providence, R. I.

Research Publications

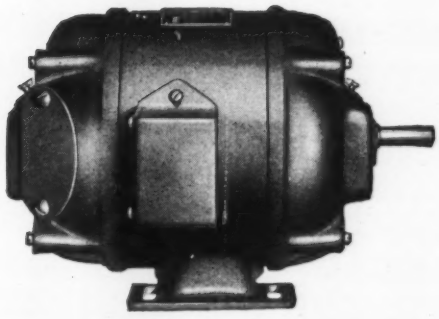
Some Experiments on Oil Films in Complete Cylindrical Bearings, by Guido H. Marx et. al. A most complete investigation covering bearing lubrication; influence of surface velocity on mean film thickness; an investigation of the mean thickness of oil films in bearings; oil film thickness in bearings; an investigation of journal positions in a bearing; and oil film pressures and journal displacements in complete cylindrical bearings. Test methods are presented, results described, shown pictorially and given in table and diagram form. Published as engineering bulletin Vol. 1, No. 1, by Stanford university, Calif. 110 pages. $1.50.

Bibliography of the Vibration of Shafts, Vibration Measurements and the Design of Crankshafts, compiled by A. C. Bates and M. J. Zucrow. A complete listing of technical articles from publications of United States and Europe on transverse vibration of shafts, torsional vibration, vibration measuring instruments, elastic hysteresis, crankshaft design, balance, crankshaft failure and design of shafts. The articles are listed by authors under the various subjects treated. There is also included a list of papers and books on the general theory of vibration and on the theory of torsion of shafts. Published as research series No. 39, by Purdue university, West Lafayette, Ind. 110 pages. $1.

Industrial Standardization. A monthly review of commercial standards and standards activities is contained in this publication formerly known as *ASA Bulletin*. The change in name has been instituted in order to indicate through the name of the publication the scope of its contents, which covers the field of standardization in general and is not confined to ASA activities. The July issue includes reviews of a number of standardization activities of interest to designers. Published by American Standards association, 29 West Thirty-ninth street, New York. 24 pages. Published for sustaining members.

Thermal Expansion of Heat Resisting Alloys (Nickel Chromium, Iron Chromium and Nickel Chromium Iron Alloys), by Peter Hidnert, bureau of standards. This paper presents data on the linear thermal expansion of the alloys between 20 and 1000 degrees Cent. With the aid of the data it is possible to select heat resisting alloys which have the same coefficients of expansion for a given temperature range as other materials and to predict the coefficients of expansion of similar new alloys. Published as RP 388 by Government Printing office, Washington. pages. Published for sustaining members.

Symposium on Rubber. This book, composed of 12 papers presented at a regional meeting of the society, makes available for engineers, concise and usable technical information on rubber and many of the important engineering materials in which rubber is used. The authors, while authorities in their fields, have written the papers to reach engineers rather than rubber technologists. Published by American Society for Testing Materials, 1315 Spruce street, Philadelphia, 160 pages. $1.75.



1/6 Horse Power Century Type RS Repulsion Start Induction Single Phase Motor.

This Means a Lot to Motor Users

Century Electric Company started in business in 1903. That in itself means nothing. But, *this* means a lot:

The first motors that ever went out under the Century trade mark "Kept a-Running," simply because they were *built right*—right from the start. They have always been *so* right that they have been actually responsible for many advancements in the electrical industry.

For instance, they played a most prominent part in popularizing the use of motorized equipment when lighting circuits were the only available source of power . . . Again, when the Electrical Refrigerator and Oil Burner Industries were in their infancy, *their motor problems had already been solved by Century*—not with a specially built motor, but with a motor *already* so right that it met every exacting service requirement

Many other similar instances could be cited to indicate Century's leading place in the picture of industrial development during the last 28 years. It points definitely to one thing:

No matter what your requirements are, you will profit by an investigation of Century Motors.

Century MOTORS

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ALTERNATING AND DIRECT CURRENT, SINGLE PHASE, POLYPHASE, SPLIT PHASE, MULTISPEED AND SPECIAL MOTORS, RANGING IN SIZE—DEPENDING ON TYPE—FROM 1/60 TO 250 H. P.

RS-1/6

FOR MORE THAN 28 YEARS AT ST. LOUIS

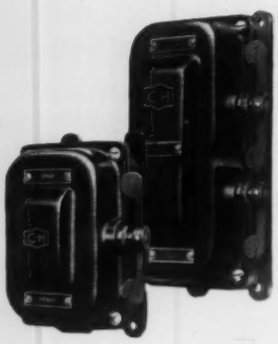
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Levers Control New Master Stations

FOR USE under severe weather or atmospheric conditions, a line of master stations has been introduced by Cutler-Hammer Inc., 328 North Twelfth street, Milwaukee, that is radically different from the usual master stations. These controls, shown herewith, are operated through levers placed on the side of the case instead of through push puttons on the front. It is claimed that by this unusual construction an absolutely watertight case is secured. The shafts of the levers operate through stuffing boxes and the cover joint is sealed by a rubber gasket, giving complete protection.

The stations use standard, heavy duty, push button elements, mounted on removable individual molded bases, fully enclosed. They are supplied in all normal ratings in one button (on and off), two button (start and stop), or three button (hoist, lower, stop) designs.

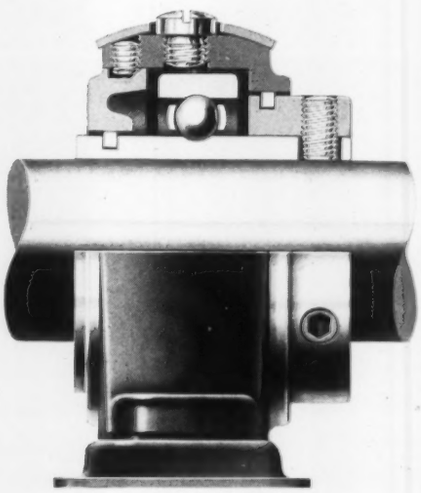


Levers instead of push buttons operate master stations which are completely watertight

Pillow Blocks Have Steel Housings

FINE appearance and finish combined with light weight, ample strength and rigidity are obtainable with the type DH-1 pillow blocks built with a formed steel housing introduced by Dodge Mfg. Corp., Mishawaka, Ind. Another exclusive feature in these new parts is the use of automotive type piston ring grease seals. These seals provide positive protection against leakage of lubricant and admission of dust and dirt.

The inner housing of the pillow blocks, shown herewith, is spherical on the outside, providing a self-aligning feature without sacrificing radial and thrust capacity of the bearing. A single row deep groove ball bearing is used. A set collar, fitted over the extended inner race, is provided with two set screws for clamping to the shaft.



Formed steel housings are innovation in design of pillow blocks that employ automotive type piston ring grease seals

The housing is of heavy gage steel formed to insure extreme rigidity and is of two-piece construction. This split feature facilitates installation or removal of the bearing. The use of this material also permits application in many situations where the smaller dimensions obtainable are suitable, while larger overall dimensions would preclude the use of antifriction bearings.

Introduces Motorized Speed Reducer

A NEW motorized speed reducer recently has been added to the line of enclosed units built by Link-Belt Co., Philadelphia. The reducer, shown herewith, is a triple reduction unit with a speed ratio of 312.2:1. The motor shaft, which extends into the reducer housing, operates at 1165 revolutions per minute while the low

(Actual Size 7 x 9¼)

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MANY of our readers will, we believe, be glad to know that because of the continued requests for reproductions of the drawings which appeared in Machine Design each month from September 1929 to December 1930 additional copies have been made available. The first of these, "James Watt and His Steam Engine", appears above—much reduced.

The entire series includes sixteen original drawings—prepared exclusively for this publication—symbolizing designers' contributions to the progress of mankind.

Illustrations are reproduced in black on fine quality, ivory tinted, dull coated paper. Each is 7 x 9¼ inches printed on a 10 x 13 sheet.

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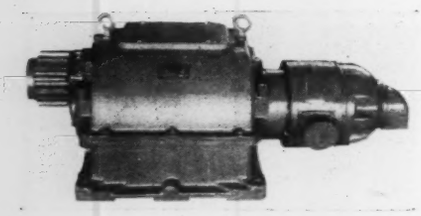
speed shaft only runs at 3.75 revolutions per minute.

Increased efficiency and compactness, reducing the floor space required, and the elimination of



Speed reducer is a triple reduction unit with a ratio

high speed, motor shaft coupling are the advantages of using a motor with an extended shaft mounted in this manner. Roller bearings and continuous tooth herringbone gears are used. The gears run in oil thus providing automatic lubrication for the gears and bearings

Widens Heating Unit Applications

CATERPILLAR type heating units, a variation of the tubular type, are now being produced by Harold E. Trent Co., Philadelphia. The adaptability of this unit as regards shape widens the use of electrical heat as applied to many

Adaptability of heating unit as regards shape widens field of electrical heat

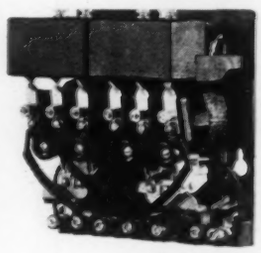
types of apparatus. In addition to the design shown in the accompanying illustration, the new units can be obtained in the form of spirals of indefinite length.

Contactors Are Interchangeable

THREE-POLE reversing magnetic contactors, interchangeable in rating and dimensions for alternating and direct currents have been developed by Industrial Controller division, Square D Co., Milwaukee. The maximum rating of the contactors, shown herewith, is three horsepower. The compact design, relatively small dimensions and convenient wiring arrangement make it particularly adaptable for hoists, window and door control, dumb waiters, reversing machine tools and similar applications.

The contactors have a positive mechanical interlock and magnetic safety latches to prevent accidental closing. They are arranged for either two or three-wire control. The edgewise mounting of the movable contacts and the form of arc suppressors are a new principle of design

Magnetic contactors are interchangeable in rating and dimensions for alternating and direct current



for increasing the arc rupturing capacity. Contactors are designated class 8711 for alternating and class 7711 for direct current.

Two Motor Types Are Redesigned

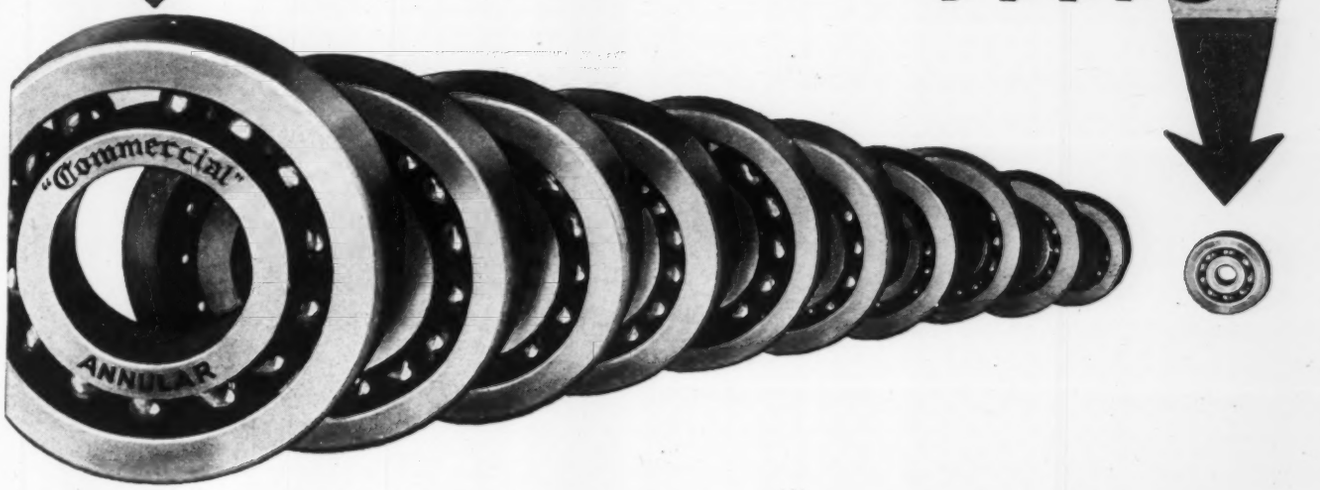
INNOVATIONS in motor design recently announced by General Electric Co., Schenectady, N. Y., include a line of splash proof induction motors and a line of direct current motors which embody many refinements of design and construction. The induction motors are designed particularly for applications in which

End shields of splash proof induction motors are of special construction

open motor operation is handicapped by the presence of splashing or dripping liquids.

The end shields of these induction motors are of special construction, the top half being solid to exclude the liquids. Cooling air enters through ventilating openings in the bottom half of the shields, and a special baffle, which extends

From THIS to THIS



AND ALL SIZES IN BETWEEN

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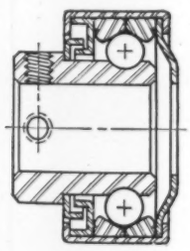

"COMMERCIAL" Annular Ball Bearings have a larger number of balls which means additional wear and strength. Speeds up to 2500 R.P.M. Dual thrust capacity and most important of all—moderate cost for quality performance.

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"Commercial" BEARINGS

to the center line of the motor shaft, prevents the entrance of splashing water into the windings. The motor frame is protected by a one-piece cover which is fitted to it. Ventilating air is circulated over the end windings, across the motor frame, and out through louvres in the cover. A watertight conduit box protects the motor leads.

Mechanically, the direct current motors are so designed that many variations, such as different degrees of enclosure for various applications, can be accomplished by using only a few different parts. New and radically different pulley-end shields afford maximum protection to the windings. Drop forged feet welded to the motor frame reduce the possibility of breakage. The improved insulation used is resistant

Direct current motors may be changed easily in design for different uses

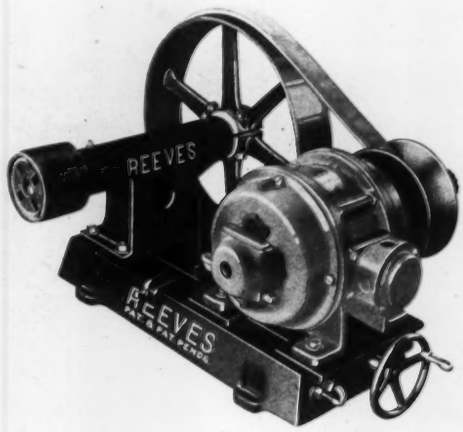
to moisture and weak acids. Properly proportioned stabilizing windings make possible unusually stable operation. In addition the speeds of all constant-speed motors can be increased 25 per cent, and more in some ratings, by field control.

Motor Pulley and Counter Shaft as Unit

DESIGNED for requirements of unusual speed reduction, the Vari-speed motor pulley countershaft unit, developed by Reeves Pulley Co., Columbus, Ind., embodies the fundamental design of the standard variable speed unit, described in the July, 1931, issue of MACHINE DESIGN, with a special ball bearing countershaft on one end of which a flat-faced pulley is mounted. This pulley receives power from the variable speed motor pulley and the motor.

On the other end of the countershaft, shown in the accompanying illustration, any type of drive, such as pulleys, multiple V-belts or chain and sprocket can be applied to transmit the power to the driven machine. The countershaft is adjustable on the base proper, permitting the selection of a pulley size which, in connection with the variable speed motor pulley, provides the reduced speed variation required on the driven shaft.

The countershaft itself is of special design, incorporating two ball bearings in each end. This unit, built in seven sizes, is available in from fractional to 7½ horsepower, and is applicable



Short belt centers are practical with use of countershaft unit shown as set for minimum speed

to many types of variable speed requirements of light horsepower requiring reduced speed. The design of the unit permits the use of short belt centers.

Develops Improved Lead Coating

COMBINING blue lead with an entirely new type of vehicle or binder, E. F. Houghton & Co., Philadelphia, has developed a prime coat that gives a tough, hard, tenacious coating, not readily scuffed off by mechanical handling, which will not chalk even after much exposure to the atmosphere. This new metal primer is made up of sublimed blue lead incorporated with a special type of vehical. Due to the new process by which it is mixed with blue lead, the vehicle forms a film hard enough to protect the blue lead, yet elastic enough to take care of expansion and contraction.

New Chain Simplifies Power Conveying

POWER conveying around turns and corners in the horizontal plane is simplified by the use of the Rex No. 137 chain recently brought out by Chain Belt Co., Milwaukee. The flexibility of the chain, shown herewith, is the result of an unique design which incorporates the universal joint feature. The bushing fits in the malleable link vertically rather than horizontally, and pin

Good Design Implies The Use of a Good Motor

Basically, a motor-driven device embodies all the characteristics of good design only when a good motor is used . . . Good design implies the use of a good motor . . . Dumore Motors are exceptionally good motors . . . Manufacturers who demand utmost quality specify them . . . They are of the universal type, are built in sizes from 1/75th to 3/4 H. P. and are available with integral Single and Double Gear Reduction Units with ratios as high as 1089 to 1 . . . Complete technical data may be had upon request. The Dumore sales and engineering staff is available for consultation at any time.

THE DUMORE COMPANY 100-A SIXTEENTH STREET RACINE, WISCONSIN

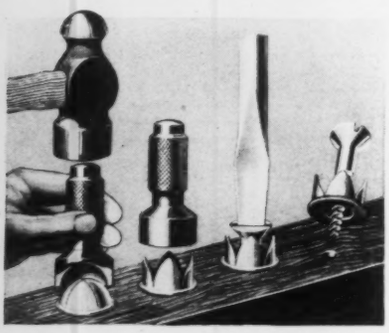
and bushing turn within the link. This revolving action, plus the fact that ample sidebar clearance is provided, allows the chain to flex around corners.

This chain, however, is at no disadvantage in straight run conveying, either on the horizontal or the slightly inclined plane. Consequently, one conveyor can be used for conveying in a straight line and around turns which makes for extreme reliability and economy. In addition, there is no drop required, which means that the conveyor can actually end at a higher point than at the start without any added complication in design.

Oval shaped holes in sidebars of links on power conveyor chain aid in providing maximum flexibility

Fastenings Improve Appearance

COMPLETELY concealing and locking bolts, screw heads or nuts, a new fastening device, known as the Lok-Crowner, manufactured by Rawplug Co. Inc., New York, offers an interesting innovation in designing both for appearance and safety. This part combines an ingenious lock washer and a metal cap. The lock washer has a four-point locking arrangement and is cup-shaped with projecting prongs which engage and securely hold the decorative cap. The rustproof caps are either drawn metal in any desired finish or molded bakelite for installations requiring electrical insulation. Caps are furnished either plain or embossed with standard or special designs and cover the lock washer completely.

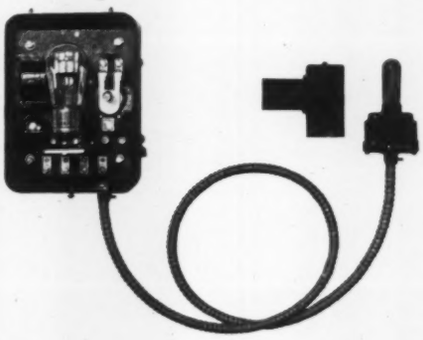


Fastening device is designed to conceal unsightly bolt and screw heads

Another fastening developed by the company is known as the Crowner. This consists of a flat washer with multiple points projecting at right angles in such a manner as to give the appearance of a crown. The Crowner is placed on the shank of the screw or bolt which is driven home. A special tool then is placed over the projecting points and tapped lightly with a hammer, drawing the points together over the center of the washer to form a smooth, hemispherical cap which conceals the screw or bolt head and seals it against tampering. The parts are made for screws, bolts and nuts of all sizes.

Improves Photoelectric Relays

A GENERAL purpose photoelectric relay with several new and important features is being manufactured by General Electric Co., Schenectady, N. Y. This relay provides more sensitive control than the models which it supersedes and at the same time will permit operation at a minimum light intensity of three foot candles, instead of ten foot candles as with previous designs.



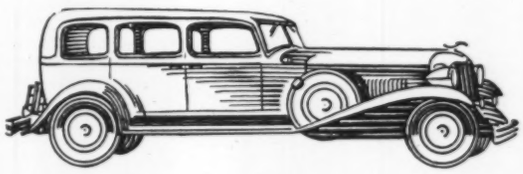
More sensitive control is provided by new design of photoelectric relay

Other features offered by the new relay include improved dielectric strength through the use of a bakelite panel, an improved phototube housing with a cast aluminum base and a drawn aluminum hood and reduced leakage due to the use of flexible armored cable between the tube and the relay proper, thus affording better operation in damp atmospheres. The relay uses a Pliotron tube especially designed for industrial applications.

Characteristic applications of the relay include the operation of magnetic counters, starting and

YOUR PRODUCT must be lighter?

Call upon Electromet Service



■ If your product must be made lighter without a sacrifice of strength, one solution is to replace ordinary steel with alloy steel parts. Before you write your specifications, however, supplement your knowledge of alloy steels with the vast fund of practical information that Electromet Service offers you without charge. As the pioneer producer of ferro-alloys and metals for steel-makers, Electromet has accumulated a body of data which, applied to your problems, will insure utmost economy in design and maximum satisfaction in performance. To realize maximum return on your investment in alloy steels, utilize Electromet Service. A request on your letterhead will bring you complete information.

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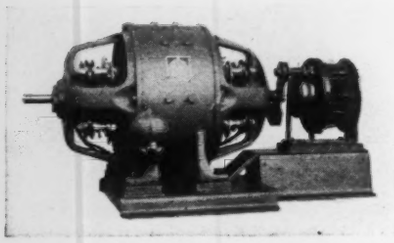
stopping machinery and control of mechanisms such as for sorting objects, aligning paper on rolls and control of bag piling machinery.

Regulators Maintain Constant Tension

CONSTANT tension regulators for use with devices such as reels for winding strip steel, copper or brass, winders for paper and cloth and other applications where it is necesary to have the material wound or pulled at a constant tension have been developed by Reliance Electric & Engineering Co., Cleveland. For any speed at which the material is being wound or treated, the regulator, shown herewith, will keep the pulling tension constant. This apparatus eliminates the need for a slipping clutch.

The armature of the regulator has two windings; the "torque" winding and the "spring" winding. The torque winding is connected in series with the motor driving the machine which is winding or pulling the material. The spring winding, so-called because it acts in a direction opposite to the torque winding like a spring, receives its power from the main line. When the current in each of these windings is equal, there is no movement in the regulator. If the current in the torque winding increases or decreases, this means an increased or decreased torque in the motor thus causing a movement in the regulator, and the rheostat which is coupled to the regulator shaft corrects the voltage to the driving motor to keep the torque constant.



Tension on reels for winding is kept constant by a unique regulating device

Gaskets Unaffected by Hot Oil

NOT even oil at a high temperature will affect gaskets of a new substance that has been developed by General Electric Co., Schenectady, N. Y. The exposed edge of the gasket is not attacked, nor does the oil penetrate it. The compound may be used in contact with cemented joints; neither dilute acids nor dilute alkaline solutions affecting it.

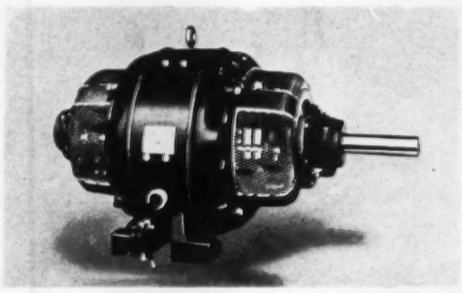
Designated as No. 1281 gasket compound, the material is a grey or brown, odorless and sulphur free alkyd resin material. It is flexible and practically incompressible and there is no noticeable hardening or stiffening in outdoor exposure tests. At present the material can be obtained in sheets up to 13 by 36 inches, in thickness up to ⅛ inch and in round shapes with a maximum thickness of ⅛ inch and diameter of 12½ inches.

Perfects Two-Ply Stainless Steel

COMMERCIALLY successful two-ply stainless steel has been perfected by Ingersoll Steel & Disc Co., Chicago. This new metal, to be known as Ingoclad stainless steel, is produced by a patented process from the composite ingot. The new material may be deep drawn, stamped, welded, formed and polished. It is being produced in various gages and sizes and has been applied to machines where protection with lowered cost is desirable. It is stated that the manufacturing process has been developed to the point where a perfect bond between the stainless steel and the carbon steel back is assured.

Synchronous Motor Is Self-Contained

ESPECIALLY developed for industrial and general purpose application, the synchronous motor brought out by Ideal Electric & Mfg. Co., Mansfield, O., is a compact, self-excited, self-synchronizing unit that requires no external excitation. The exciter windings on the motor, shown herewith, direct current commutator, etc., are integral with the motor itself. Since no field switch or synchronizing relay is necessary, this motor is started with a simple hand operated compensator.

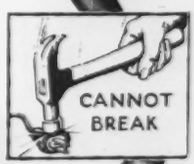


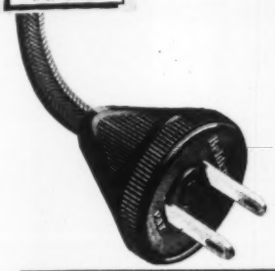
Self-excited, self-synchronizing motor is operated by ordinary controls

This is a true synchronous motor having all the advantages of the conventional motor with the additional advantages of greater compactness and simpler control equipment. It also possesses the unique ability to resynchronize itself automatically after having been pulled out of step by a line voltage dip or a momentary overload. The motors are supplied in all sizes from 5 to 100 horsepower.

Specify SAFE — ECONOMICAL — TROUBLE-FREE CORDS for your Appliances

Equipped with the Belden Soft Rubber Plug





The successful, far-sighted distributors are demanding appliances equipped with safe cords and the Belden Soft Rubber Plug for their 1932 lines.

Belden Cords, labeled every five feet with Underwriters' Machine Labels and equipped with the nationally advertised Belden Unbreakable Soft Rubber Plug, represent the highest quality in safe and trouble-free appliance cords.

The Belden Complete Cut Cord Service covers every manufacturing requirement, and tremendous production has resulted in savings which make it the most economical.

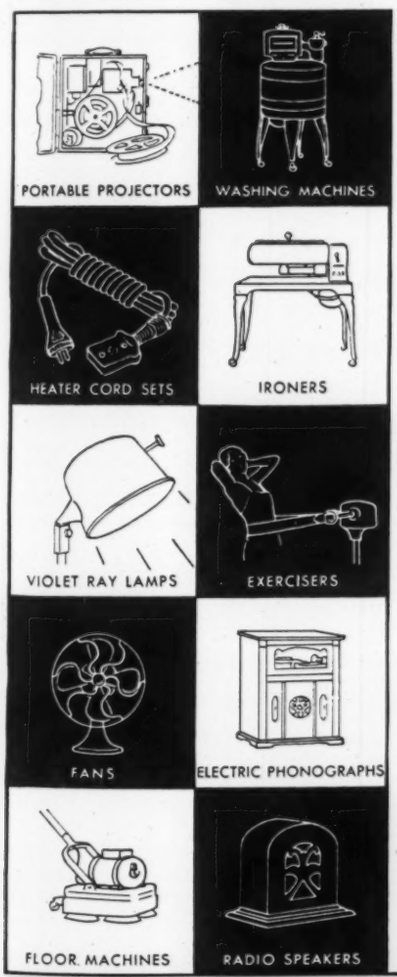
Write for complete information on your cord requirements.

Belden Manufacturing Company
4639 West Van Buren Street, Chicago

The Belden Soft Rubber Plug is fully covered by patents in the United States and many foreign countries. Licensees: Anaconda Wire and Cable Co., General Cable Corporation, Rockbestos Products Corp., and Northern Electric Co., Ltd. of Canada.

Belden
Cut Cord Service

STANDARD EQUIPMENT ON:



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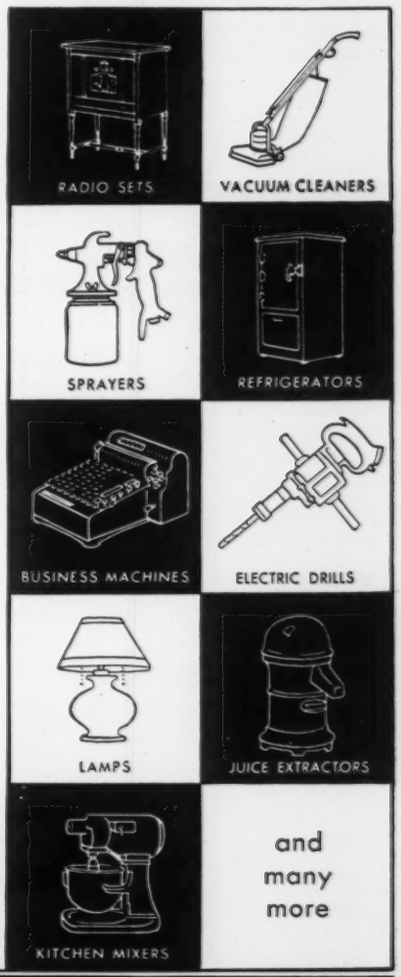


Approved Cords with Belden Soft Rubber Plugs

Business and Sales Briefs

REVERE COPPER & BRASS INC., New York, recently opened a sales office in San Francisco at 1615 Russ building. R. H. Binns Jr., Pacific Coast manager in charge of this office, was formerly assistant sales manager of the Rome division for the company and before that was engaged in the metal distribution business.

* * *

John R. Cassell, associated with the Charles Bruning Co. for the past ten years, is in charge of a newly established department for the manufacture and merchandising of drawing, tracing and detail papers within the organization of National Consumers Paper Corp., New York.

* * *

Robert K. Plummer, formerly assistant sales manager for Gears & Forgings Inc., Cleveland, has joined the sales staff of Perkins Machine & Gear Co., Springfield, Mass. Mr. Plummer will represent the Perkins company in the Cleveland and Chicago territories as a gear specialist.

* * *

Magnetic Mfg. Co., Milwaukee, has appointed Lindrooth, Shubart & Co., Boston building, Denver, its representative in Denver territory. The new agency will handle the entire line of magnetic separators, clutches, conveyor rolls and other equipment. Engineering service will also be provided.

* * *

Worthington Pump & Machinery Corp., with executive offices at 2 Park avenue, New York, and general offices at Harrison, N. J., will transfer and consolidate its designing, engineering and manufacturing activities formerly carried on its Cincinnati works with those at Buffalo. Cincinnati plant equipment will remain intact for the present and the Cincinnati district sales office will not be affected, Earl Vinnedge remaining in charge.

* * *

Stephens-Adams Mfg. Co., Aurora, Ill., manufacturer of conveyors, has established a branch office in the Cutler building, Rochester, N. Y. F. H. Wisewell is district engineer in charge of sales and engineering for the entire line of conveying, screening and variable speed transmission machinery.

* * *

Robert Gregg, former president of Atlantic Steel Co., Atlanta, Ga., has succeeded Willard Wilson as vice president in charge of sales of the Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., important southern subsidiary of United States Steel Corp.

* * *

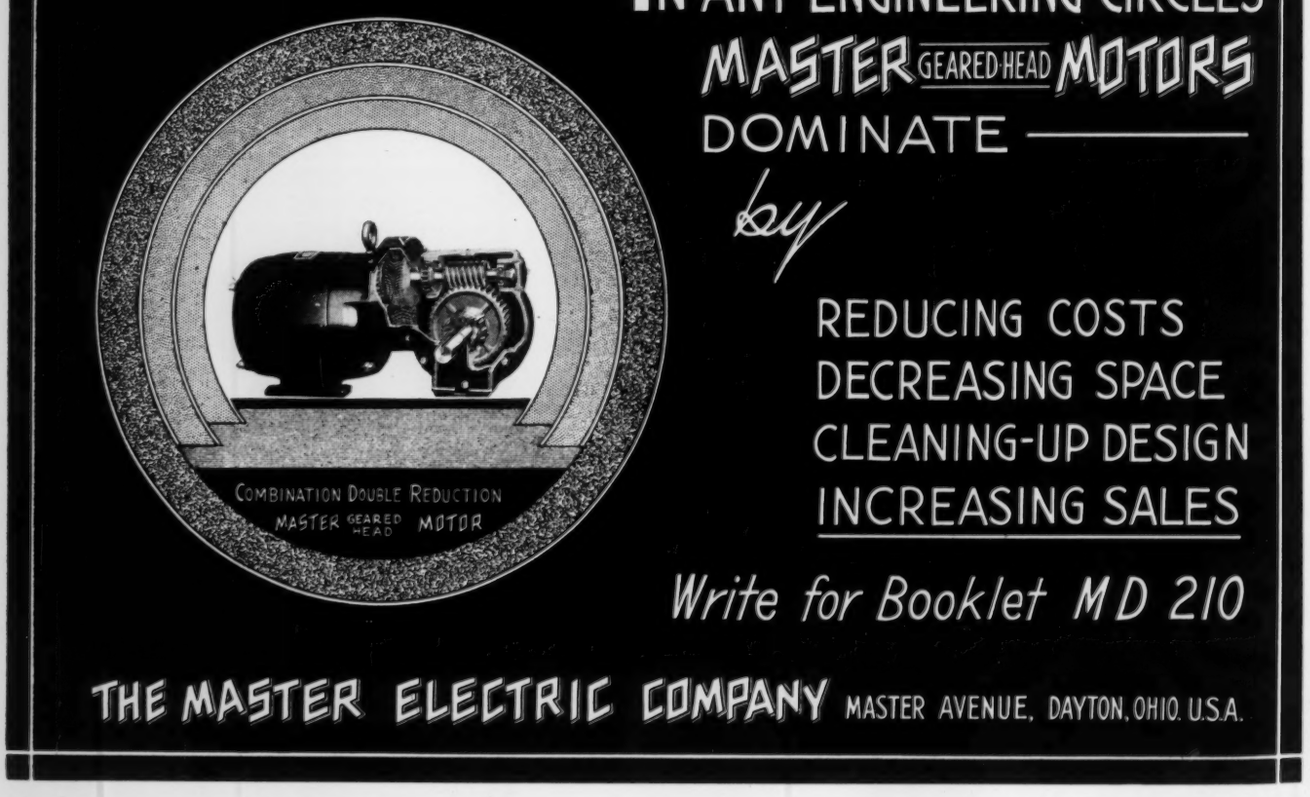
General Alloys Co., Boston, has appointed the Cleveland Duplex Machinery Co., Penton building, Cleveland, its representative in the Cleveland district. G. J. Hawkey is head of the Duplex organization, which will handle service as well as sales.

* * *

C. Thomas Best is president of the newly formed American Shim Steel Co., 1304 Fifth avenue, New Kensington, Pa., organized for the purpose of manufacturing and distributing shim steel to machinery builders, railroads, etc. The company will furnish all sizes of shim steel.

* * *

E. F. Sells recently was appointed as manager of the Washington office of the Westinghouse Electric & Mfg. Co. to fill the vacancy caused by the death of B. H. Hamilton. Mr. Sells has been associated with the Westinghouse company since 1911, serving in the Denver, El Paso and Washington offices and specializing in ship propulsion machinery and marine equipment.



HOW MANY BREAKDOWNS *make a failure?*

● We've all seen it happen many times. A splendidly designed piece of equipment is added to the line, accepted by our customers, everything starts off swell—blooey!—the deluge!

First thing we know a piece of machinery that is right as right can be gets the reputation of being a pile of junk.

Who's to blame? The designer? Nope! The customer's employees? No, sir!

It isn't a "who", but a "what" and that "what" is what is the matter with a good slice of industry—faulty, junky lubrication.

Many designing engineers today avoid trouble by specifically specifying Genuine Alemite Lubricants to be used exclusively on their products. Smart heads!

May we tell you the complete Alemite story from the designer's standpoint?

ALEMITE CORPORATION, (Division of Stewart-Warner). 618
2644 N. Crawford Avenue, Chicago, Illinois.
Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name .....

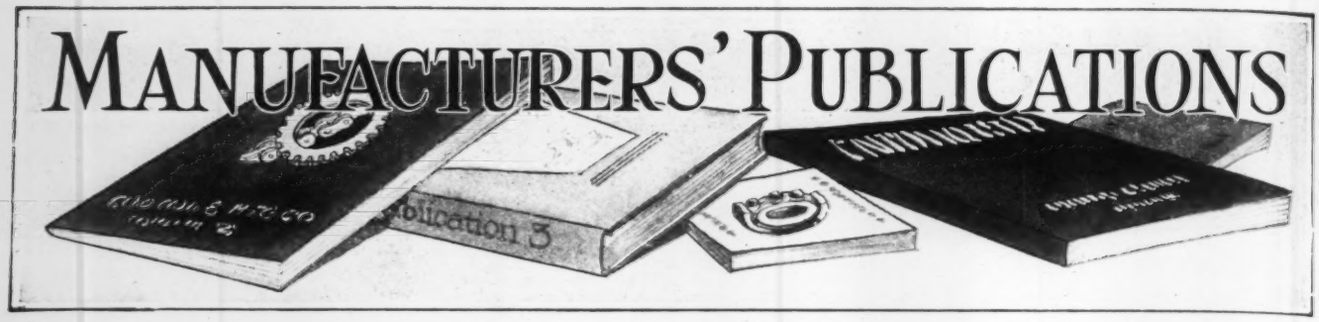
Company .....

Address .....

City ..... State .....

PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (NICKEL)—International Nickel Co. Inc., New York, includes in the spring edition of *Inco* comprehensive articles on the roller bearing locomotive, the use of cylindrical shapes produced by centrifugal castings giving the method and physical and chemical properties, properties and application of nickel tubing, a problem in brake drum iron and similar topics.

BEARINGS—Self-aligning, ball bearing pillow blocks, type DH-1, are covered in bulletin A-117 of Dodge Mfg. Co., Mishawaka, Ind. The bulletin gives complete details of construction. An innovation is the use of a formed steel housing, combining light weight, ample strength and rigidity. Another exclusive feature is the use of automotive type piston ring grease seals.

CAST PARTS—High test cast iron and method to produce it economically are presented in the first edition of *The Whiting Founder*, issued by Whiting Corp., Harvey, Ill. The publication includes an article on low cost, high test iron.

CAST PARTS—High grade steel castings and a description of some of their applications are included in a bulletin prepared by West Steel Casting Co., Cleveland. The bulletin also gives physical properties of four of the alloys produced by the company.

CAST PARTS—The properties developed by vanadium alloy steel castings are covered in an article reprinted by Vanadium Corp. of America, New York. The article, written by two engineers of the company, gives typical chemical compositions of suitable alloys steels and the properties of the resultant alloys. Photomicrographs of the steels are included, as well as typical applications.

CAST PARTS—Shenango-Penn Mold Co., Dover, O., has prepared a number of loose leaf notebook sheets on the alloys manufactured by the company. The sheets cover "Standardizing the Nonferrous Alloys Specifications," "A Quick Reference for Finding the Alloys for a Specific Use," chemical and physical properties of four alloys, recommended uses with comparative specifications, "A Brief History of the Origination and Development of the Centrifugal Process" and a conversion table for decimal equivalents.

CAST PARTS—A practical treatise dealing with the composition, properties, manufacture and application of Taurus bronze castings for engineering purposes, with an illustrated commentary on the control, manufacture, testing and application of the castings has been prepared in booklet form by David Brown & Sons Ltd., Huddersfield, England. Full particulars of the chemical analysis and physical properties of the special bronzes made are given. The booklet is also an attempt to educate the purchaser to enable him to use discrimination in the purchasing of bronze castings. A nominal charge of 25 cents is made for the booklet.

CLUTCHES—The installation and use of magnetic clutches for special and general power transmission applications is presented in a 16-page bulletin issued by Dings Magnetic Separator Co., Milwaukee. The bulletin describes three types of clutches manufactured by the company—single disk, multiple disk and serrated disk. Extensive tables of performance data are included with the method of calculating the required horsepower rating.

CONTROLS (ELECTRICAL)—Bulletin 609 hand operated starting switches built by Allen-Bradley Co., Milwaukee, are presented in a recent catalog insert issued by the company. The switches are equipped with overload relays and have double break, silver-to-silver contacts.

CONTROLS (ELECTRICAL)—General Electric Co., Schenectady, N. Y., has prepared a folder, GEA-1583, on its line of relays. The folder outlines the opportunities presented by application of the relays and covers high speed, directional distance, directional overcurrent and time induction types.

COPPER AND BRASS—Revere Copper & Brass Inc., New York, has issued a new and larger edition of its semiannual catalog which presents in book form all of the products manufactured by the company. The catalog includes sheets, rolls, strips, anodes, extruded and drawn shapes, forgings, thin metal, plates, rods and wire, tubes and pipe, general information and engineering tables and data. All of the divisions included specifications for Herculoy, the new alloy of the company.

DRIVES—Fully enclosed variable speed transmissions designed to meet extreme conditions in certain industries where exposure to abrasives, acids, oil, steam, water, etc., is encountered are covered in a folder published by Lewellen Mfg. Co., Columbus, Ind. The transmissions are described fully, dimensions are given, and photographs show applications and cross sectional views.

FASTENINGS—Complete details of self-locking screw threads are presented in Bulletin No. 5 of Dardelet Threadlock Corp., New York. The most recent revised edition of the bulletin explains the locking principle, gives types of fastenings on which the thread is applicable, outlines the advantages of this type of locking device and gives other details of interest.

FINISHES—E. F. Houghton & Co., Philadelphia, has prepared a 32-page bulletin on its line of finishes. These include colors, metal primers, acid compounds, etc. Directions for applying and diluting are given.

FINISHES—Grasselli Chemical Co., Cleveland, is distributing a booklet on Cadalyte, a process and product for cadmium plating. The booklet describes the product and process, explains its applications and advantages, sales and

IRON FIREMAN MANUFACTURING CO

The IRON FIREMAN Automatic COAL BURNER

PORTLAND, OREGON, U.S.A.

PLEASE ADDRESS REPLY TO
3170 WEST 106TH STREET
CLEVELAND, OHIO

April 29, 1932

General Electric Company
Cleveland, Ohio

Attention: Mr. F.C. Davern

Gentlemen:-

It occurs to us that you might be interested in knowing why we equip our product with General Electric motors.

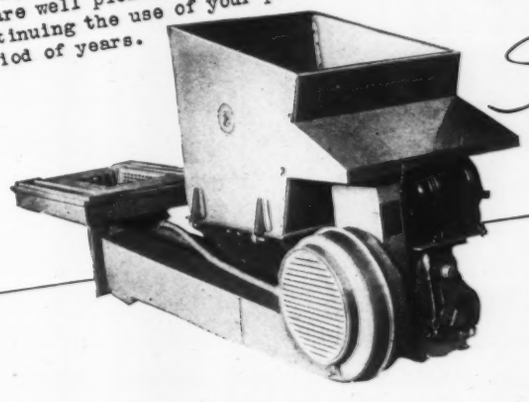
In the first place the General Electric representatives whose duty it has been to contact this organization have always thoroughly understood their business and have been able to give us detailed and accurate information covering any particular phase of application that we might have under investigation. Then again, the General Electric Company appreciates the fact that there are always two sales to be made of any piece of apparatus.

The first sale which represents the exchange of merchandise for its equivalent market value, is often the easier of the two. The second sale is the sale to the man who is using the product and with this sale, service must be rendered with a spirit of willingness and helpfulness to the end that the actual user is pleased with his purchase; learns how to use it in such manner that he does not subject it to abuse; willingly gives the apparatus the care to which it is legitimately entitled.

The General Electric Company seems to have grasped the fact that this second sale is of uttermost importance and it has so organized its field force that the service necessary is quickly, efficiently, and intelligently provided. A well-posted Sales Department backed by an efficient Service Department, which is again backed by an excellent product, is pretty nearly an unbeatable argument for any piece of apparatus.

Our actual experience with the motors and accessories as manufactured by the General Electric Company has convinced us of the fact that the Manufacturing Department does everything within its power to produce a first-class piece of mechanism, and that it has succeeded is evidenced by the fact that our customers are well pleased, that complaints are few and far between, and that we are continuing the use of your product after actual experience with it over a period of years.

Yours very truly,
W.H. Gray
W.H. Gray
Chief Engineer



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GENERAL ELECTRIC